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An Economic Study of Land Utilization in Yates County, New York

224

M. D. Woodin

USES OF LAND IN YATES COUNTY

Vineyards and general farming are important in Yates County. The lakes offer excellent recreational opportunities

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SUMMARY

In the past 150 years, many changes have taken place in the use of the land in Yates County. About 8 per cent of the land in farms in 1910 has since gone out of agricultural use. The acreage of small grains has decreased, while in recent years the acreages of corn for silage, beans, cabbage, and alfalfa have greatly increased. Sheep have decreased in importance. (Pages 7 to 12.)

Based on present land use, soils, size and condition of farm buildings, topography and elevation, and market facilities, the land has been divided into nine land classes. Land classes I and II are better adapted to forests and recreational uses than to farming. They comprise 36.6 per cent of the county. Land classes III, IV, and V, which probably will remain permanently in agriculture, comprise 57.2 per cent of the county. (Pages 13 to 17.)

The higher the land-class number, the more intensively the land is used, and the greater have been the profits from farming. In land class V, about 29 per cent of the land was in intertilled crops, as compared with less than 1 per cent in land class I. About 16 per cent of land class II was used for sheep pasture. (Pages 17 to 21.)

The higher the land class, the larger is the proportion of productive soils. In land class V, about 90 per cent of the soils are well drained and contain lime, while in land classes I and IR only 1 per cent have both good drainage and lime. Ontario loam is the most important well-drained soil containing lime. (Pages 21 to 29.)

In land class I, 56 per cent of the houses standing in 1900 were gone or uninhabitable in 1938. The proportion of vacancies was twice as great in land classes I and II as in land class V. (Pages 29 to 31.)

Most of the land in the higher land classes is below 1250 feet in elevation; nearly one-half of land class I is above 1550 feet. (Pages 31 to 32.)

The full value of land and buildings per acre in farming areas ranged from $20 in land class I to $91 in land class V. (Pages 31 to 35.)

A greater proportion of the classified farms in the higher land classes were operated by Farm Bureau members than in the lower land classes. About two-thirds of the Farm Bureau members participated in the 1939 Agricultural Conservation Program, while only 15 per cent of nonmembers participated. (Pages 34 to 36.)

School costs per pupil are relatively high in land classes I and II, because the number of pupils per school is small in such sparsely settled areas. State aid makes up a large proportion of the income of districts in these land classes. (Pages 34 to 38.)

More fire insurance was carried per farm and fire protection was better in the higher land classes. (Pages 38 to 39.)

Of the 785 miles of road in the county in 1939, about 365 miles were all-weather roads. Of these, 201 miles were hard-surfaced and 164 miles sub-based or heavily graveled. It is suggested that an additional 151.5 miles be improved as all-weather roads. About 35 miles of road in land classes I and II have been abandoned. (Pages 40 to 44.)

On February 15, 1939, there were about 224 miles of rural electric distribution lines. One-half of the farms and two-thirds of the rural residences had electric service available. To serve all farms and residences in permanent agricultural and rural residential areas, about 176 miles of new lines are needed. (Pages 43 to 47.)

To provide telephone service for all of these properties would require about 66 miles of new lines. (Pages 47 to 50.)

The reforestation of land classes I and II will prevent persons from trying to farm land much of which never should have been cleared. (Pages 50 to 52.)

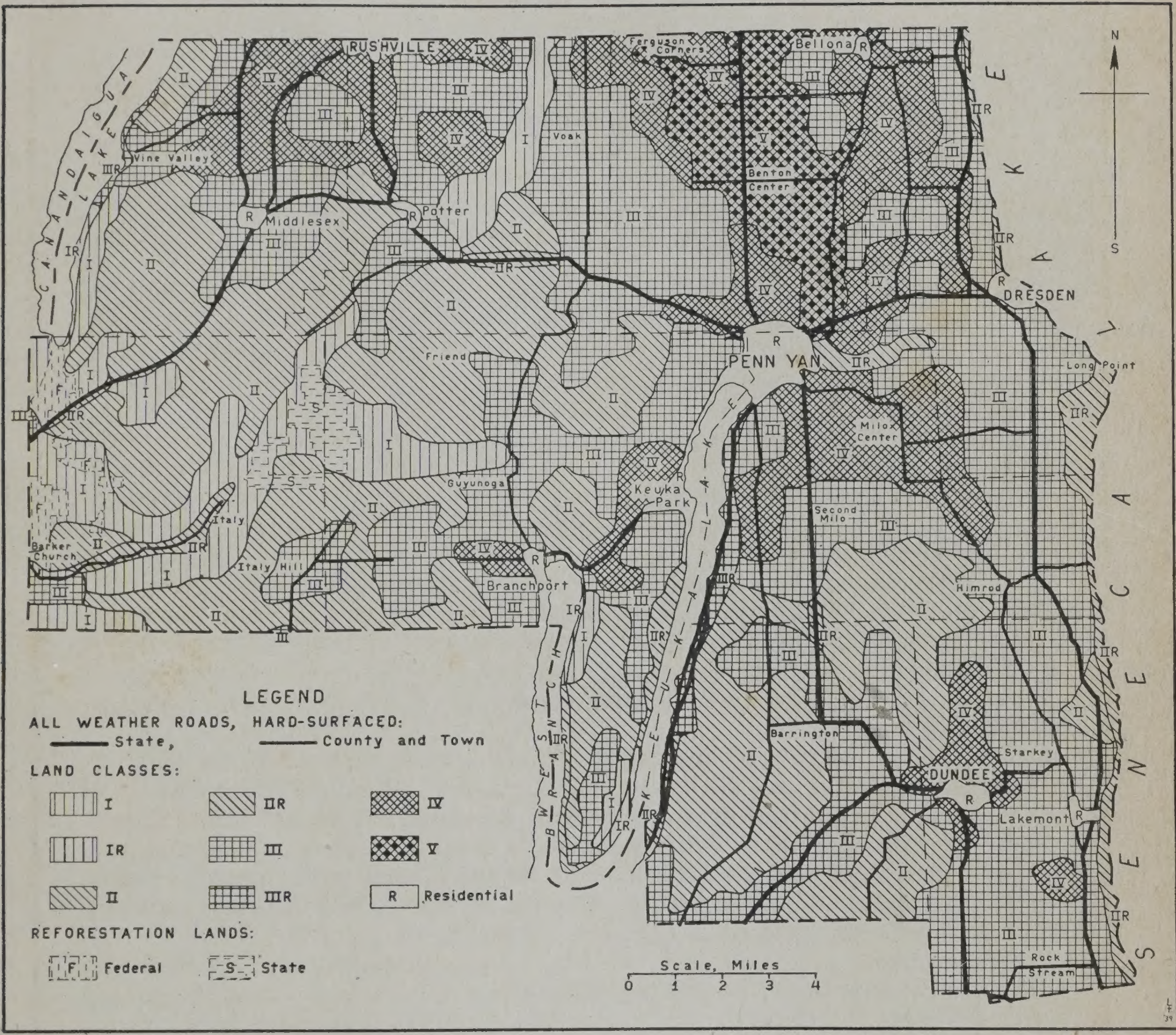

Figure 1. LAND-CLASSIFICATION MAP OF YATES COUNTY

The higher the land-class number, the greater is the intensity of use to which the land is adapted

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AN ECONOMIC STUDY OF LAND UTILIZATION IN YATES COUNTY, NEW YORK

M. D. Woodin

PURPOSE

When the first white settlers came to Yates County, they had no way of distinguishing between good and poor farm land. Practically all of the land was settled. Some of it produced excellent crops, but some could not be farmed profitably. Much of the land not suited for farming has been abandoned, but part of it is still in use.

The primary purposes of an economic classification of the land in Yates County are to assist those who are interested in the land to use it for the purposes for which it is best adapted and to form a basis for the development of services in rural areas. Areas that are adapted to permanent agriculture should be served by all-weather roads, electric and telephone lines, adequate health facilities, and good schools. Farm fire insurance and farm credit should be available at a reasonable cost. Areas not adapted to farming may well be used for forests and recreational purposes.

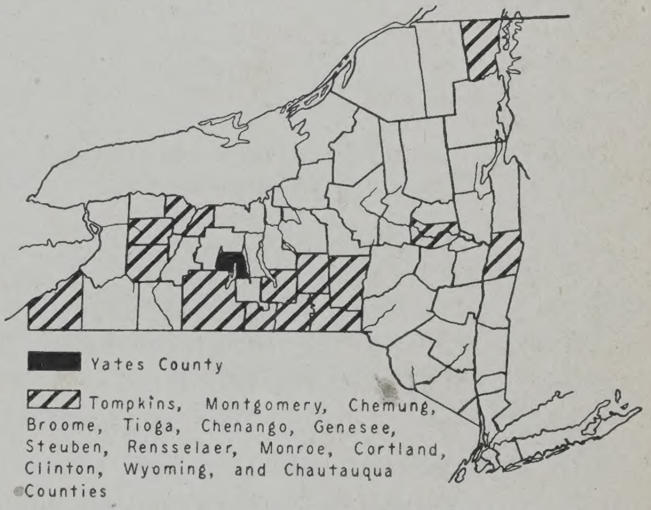
■ Yates County
▨ Tompkins, Montgomery, Chemung, Broome, Tioga, Chenango, Genesee, Steuben, Rensselaer, Monroe, Cortland, Clinton, Wyoming, and Chautauqua Counties

FIGURE 2. LOCATION OF YATES COUNTY AND OF OTHER COUNTIES FOR WHICH LAND-UTILIZATION BULLETINS HAVE BEEN PUBLISHED

Studies similar to this one of Yates County have been completed in fourteen other counties (figure 2).

DESCRIPTION OF THE AREA

LOCATION

Yates County is in the Finger Lakes region of west-central New York (figure 2). It is one of the smallest and most rural of New York counties. The land area is 343 square miles, or 219,520 acres. Penn Yan, near the center of the county, is the county seat.

AUTHOR'S ACKNOWLEDGMENTS. The author wishes to acknowledge the assistance given to this study by:

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The county and town highway officials, who gave valuable suggestions regarding the road program, and the town assessors, who assisted in locating the properties.

ELEVATION, TOPOGRAPHY, AND CLIMATE[1]

The elevation ranges from about 450 feet above sea level along Seneca Lake to over 2100 feet in the southwestern part of the county. The topography is smooth to rolling in the northern and eastern towns, but hilly and rough in the southwestern towns.

The average length of the growing season at Penn Yan is 153 days (table 1). Two-thirds of the growing seasons during an 18-years period included 140 days or more.

TABLE 1. AVERAGE LENGTH OF GROWING SEASON, PENN YAN AND GENEVA,* NEW YORK

Station	Period observed	Growing season		Proportion of growing seasons less than—			
		Average length	Shortest on record	120 days	130 days	140 days	150 days
	Years	*Days*	*Days*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Penn Yan..........	18	153	105	11	11	33	44
Geneva............	22	162	116	5	14	23	27

*Geneva is at the end of Seneca Lake, about 8 miles north of the Yates-Ontario county line.

The slopes along Lake Keuka are adapted to the production of grapes because of adequate air drainage and because the moderating effect of the water retards bud development in the spring until danger from frost is over and also prevents early fall frosts.

Part of Yates County is in a relatively small area of central New York which receives an annual rainfall of 30 inches or less. The average annual precipitation at Penn Yan is 29.1 inches (table 2). The rainfall during the growing season (May 1 to September 30) averages 14.8 inches at Penn Yan and 15.0 inches at Starkey in the southeastern part of the county.

TABLE 2. AVERAGE ANNUAL AND GROWING-SEASON PRECIPITATION, YATES COUNTY, NEW YORK, AND ADJOINING COUNTIES

Station	Period observed	Elevation	Precipitation	
			Annual	Growing-season (May 1 to Sept. 30)
	Years	*Feet*	*Inches*	*Inches*
Yates County:				
Penn Yan..........................	82	730	29.1	14.8
Starkey...........................	5	860	36.8	15.0
Adjoining counties:				
Geneva............................	43	615	33.5	16.2
Prattsburg........................	9	1,494	32.9	16.3

TRANSPORTATION FACILITIES AND MARKETS

Yates County is served by three railroads and about 200 miles of hard-surfaced highways (figure 3). To permit efficient marketing of farm produce, it is desirable that the secondary roads which serve the permanent farming areas be improved as all-weather roads.

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[1] The climate of New York State. By R. A. Mordoff. Cornell Univ. Agr. Exp. Sta. Bul. 444: 73–88. Revised 1934.

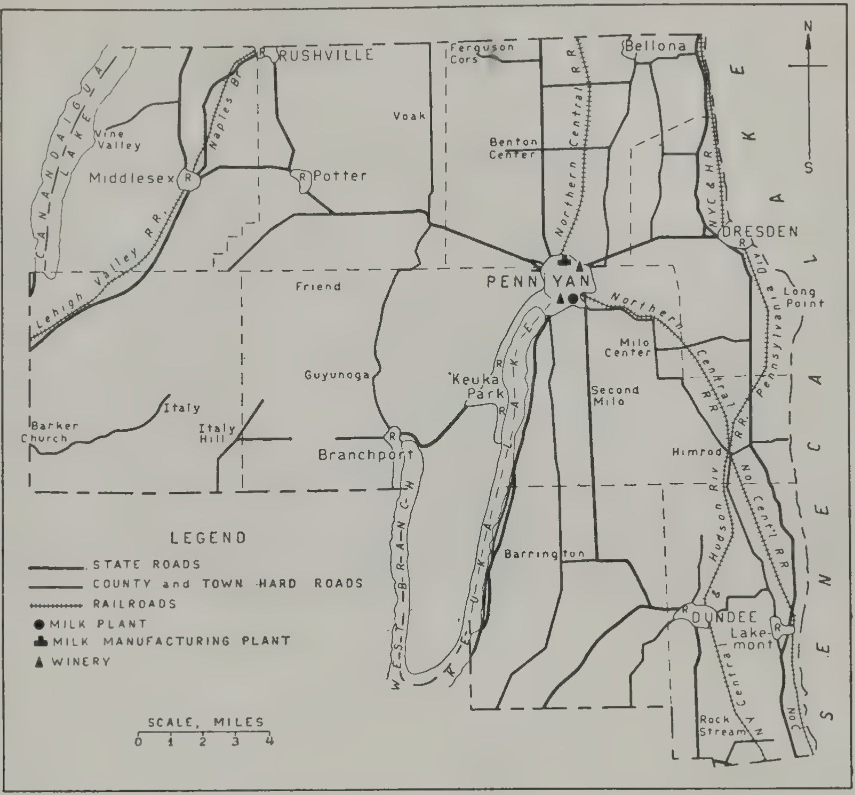

FIGURE 3. HARD-SURFACED ROADS, RAILROADS, MILK PLANTS, AND WINERIES IN YATES COUNTY, FEBRUARY 15, 1939

Penn Yan, Dundee, and Rushville are the leading trading centers of the county, and are local markets for milk, fruit, and other farm produce. A butter-manufacturing plant and a grade-B milk plant authorized to handle milk for the New York City market are located at Penn Yan. Cream-receiving stations at Gorham and Prattsburg and a cheese factory at Watkins Glen are markets for a small amount of milk from Yates County.

On 100 grape farms on Bluff Point, studied in 1935, about one-half of the grape crop was sold to trucker-dealers, one-fourth to wineries, and the remainder to various other types of buyers.[2]

HISTORY OF THE AGRICULTURE IN YATES COUNTY[3]

The first white settlement was made along Seneca Lake in 1787 by the followers of Jemima Wilkinson. Shortly after 1790, the influx of settlers began and the development of the land for farming was started. The towns of Jerusalem and Middlesex were organized in 1789, but county government was not established until 1823, when Yates County was formed from a part of Ontario County.

The first agriculture was necessarily self-sufficing. At first farm products for outside markets were moved largely by boat. The building of the first railroad through the county in 1852, and later the development of a highway system, encouraged the commercialization of agriculture and the production of perishable farm products for sale.

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[2] An economic study of grape farms in Schuyler and Yates Counties, crop year 1935. By E. G. Misner. Cornell Univ. Agr. Exp. Sta. Bul. 670. 1937.

[3] Data from *Historical and Statistical Gazetteer of New York*, 1860.

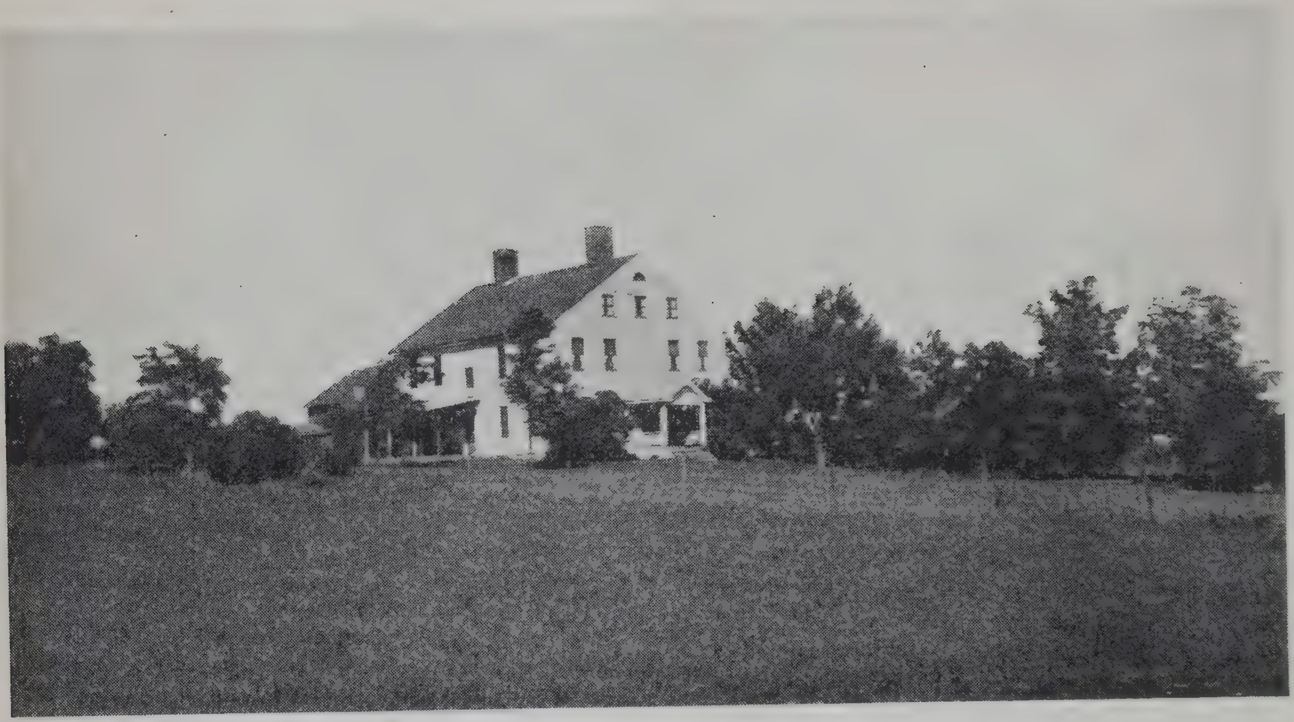

FIGURE 4. ORIGINAL HOME OF JEMIMA WILKINSON, BUILT ABOUT 1790

LAND IN FARMS

The acreage in farms did not vary greatly from 200,000 acres from 1860 to 1920 (table 3). A decline of about 13,000 acres occurred from 1920 to 1930, but a slight increase over 1930 was reported by the 1935 Census.

TABLE 3. NUMBER OF FARMS AND ACREAGE OF LAND IN FARMS, YATES COUNTY, NEW YORK, 1850 TO 1935*

Year	Farms		Land in farms		Average acreage per farm
	Number	*Index (1910 = 100)*	*Acres*	*Index (1910 = 100)*	*Acres*
1850	†	†	186,500	91	†
1860	1,940	85	202,758	99	105
1870	1,961	86	199,778	98	102
1880	2,279	100	‡	‡	‡
1890	2,473	108	196,255	96	79
1900	2,504	109	203,568	100	81
1910	2,288	100	204,214	100	89
1920	2,041	89	198,613	97	97
1925	1,997	87	194,674	95	97
1930	1,739	76	185,999	91	107
1935	1,768	77	188,074	92	106

*Data from United States Censuses.
†The number of farms by counties was not reported in the Census of 1850.
‡Data for 1880 were omitted because of errors made in the enumeration of the Census of 1880. Too large an acreage of land in farms was reported. See *Twelfth Census of the United States, 1900*, vol. 5, p. 19.

CROPS

The total acreage of important crops increased from about 86,000 acres in 1854 to about 106,000 acres in 1889 (table 4 and figure 5). The Census of 1935 reported about 19,000 acres less than did the Census of 1890. In 1854 and 1874, the acreage of small grains was about twice that of hay crops; by 1934, the acreage of grains had decreased so that there were about twice as many acres of hay as of small grains.

TABLE 4. Acreage of Important Crops and Number of Apple Trees and Grape Vines, Yates County, New York, 1854 to 1934*

Crop	1854	1874	1889	1899	1919	1929	1934
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Alfalfa hay	......	......	......	35	1,371	3,609	6,533
Other hay	23,372	28,300	38,944	36,436	43,648	27,057	33,501†
Oats	11,480	15,551	14,775	19,123	10,912	5,659	6,334
Barley	12,486	14,044	16,877	3,314	3,682	2,205	2,114
Mixed grains	......	......	......	......	3,566	6,632	5,408
Buckwheat	4,434	1,866	3,046	3,424	2,522	3,718	‡
Wheat	20,211	25,265	14,337	22,431	17,812	9,766	11,646
Rye	2,146	2,224	6,976	1,802	4,532	1,307	1,699
Corn for grain	11,104	10,622	9,317	10,865	5,951	2,940	4,506
Corn for silage	......	......	......	......	771	1,587	1,498§
Potatoes	1,018	1,726	1,927	2,850	1,786	1,275	1,947
Beans (dry)	92	460	......	5,618	3,440	8,691	11,279
Cabbage	......	......	......	......	....	461	1,084
Total‖	86,343	100,058	106,199	105,898	99,993	74,907	87,549
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Apple trees, bearing age	......	197,004¶	191,184	184,354	155,345	124,038	111,552
Apple trees, not of bearing age	......	......	......	....	40,273	7,358	4,448
Grape-vines, bearing age	......	6,748**	......	4,802,617	4,025,703	4,004,645	3,819,650
Grape-vines, not of bearing age	......	......	......	....	89,465	113,077	57,380

*Data for 1854 and 1874 are from New York State Censuses. Data for 1889 to 1934 are from the United States Censuses.

†Includes 8782 acres of annual legumes saved for hay, which had a yield of 4652 tons.

‡The acreage of buckwheat was not reported in the Census of 1934.

§The 1934 Census reported "corn for all purposes" and "corn for grain." To obtain the acreage of "corn for silage" in 1934, "corn for purposes other than for grain" was apportioned the same as in 1929, when the acreage for each purpose was reported.

‖Includes only the important crops listed. The acreage of minor crops was not reported by all of the censuses.

¶All ages.

**The number of vines of all ages reported by the Census of 1864. The Census of 1874 did not report the number of grape-vines.

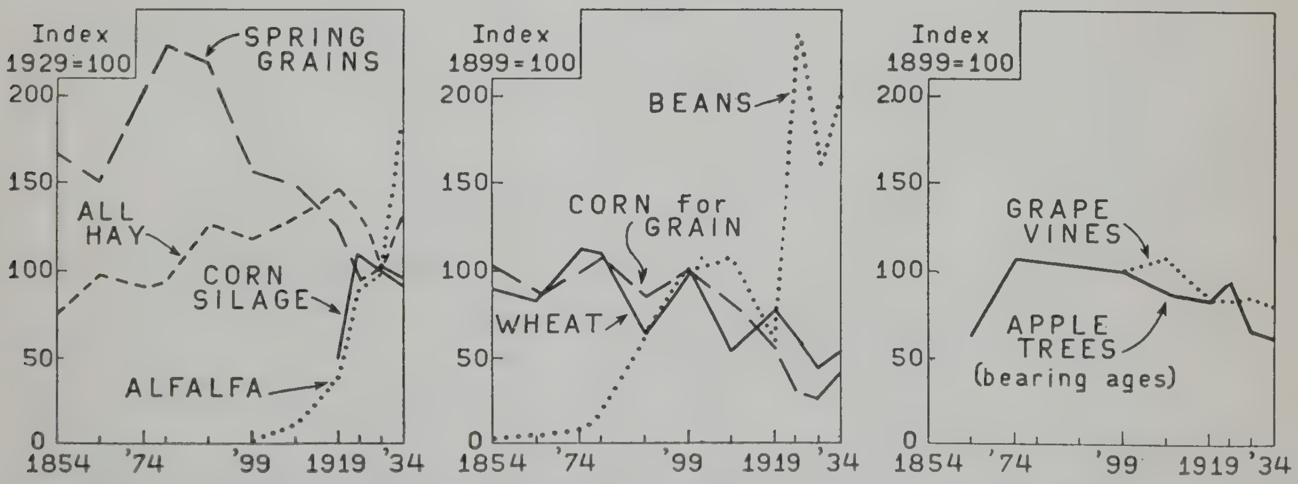

Figure 5. indices of crop acreages and of numbers of apple trees and grape-vines in yates county, 1854 to 1934

The acreages of grains have declined, while the acreages of alfalfa, corn for silage, and beans have increased. The numbers of apple trees and grape-vines have decreased

Alfalfa and corn for silage have become more important in recent years. From 1919 to 1934, the acreage of alfalfa increased from 1371 acres to 6533 acres, and the acreage of corn for silage nearly doubled.

From 1929 to 1934, there was a sharp increase in the acreage of dry beans, from 8691 to 11,279 acres. During the same period, the acreage of cabbage more than doubled, from 461 to 1084 acres.

Yates County ranks second to Chautauqua County in the acreage of grapes. In 1899, there were nearly five million vines in the county. Because of higher costs of production on the steeper slopes along the lakes and relatively low grape prices in recent years, the number of vines has declined. In 1934, fewer than four million vines were in production. The planting of new vineyards has been curtailed.

The number of apple trees decreased by nearly one-half from 1874 to 1934; few young trees have been planted recently. For every nine young trees in 1919, there was only one in 1934. This change has occurred because of the disappearance of farm orchards and a shift of commercial apple production to more favorable areas.

Average crop yields have been increased since 1854 by the use of better varieties of crops, improved cultural practices, modern machinery, lime, and fertilizer, and by the abandonment of some of the land not adapted to farming. The yields of small grains have increased most (table 5). Although the greatest increases in yields occurred before 1900, the yields of most crops have shown some improvement since then.

TABLE 5. AVERAGE YIELDS PER ACRE OF IMPORTANT CROPS FROM 1854 TO 1929, YATES COUNTY, NEW YORK*

Crop	Unit	1854 and 1864	1874, 1879, 1889, and 1899	1909, 1919, 1924, and 1929
Hay (all kinds)	Tons	0.9	1.1	1.2
Oats	Bushels	16.0	29.9	27.4
Barley	Bushels	13.0	22.2	23.0
Buckwheat	Bushels	9.1	14.2	15.7
Wheat	Bushels	10.1	15.9	21.1
Rye	Bushels	8.7	14.2	15.4
Corn for grain	Bushels	26.6	38.9	36.7
Corn silage	Tons	....	....	7.3†
Potatoes	Bushels	89.5	87.3	96.8
Beans (dry)	Bushels	11.7	12.4‡	10.5§

*Data for 1854 to 1874 are from the New York State Censuses. Data for 1879 to 1929 are from the United States Censuses.

†The yield of corn silage is for 1919, 1924, and 1929 only.

‡The yield for beans is for 1874 and 1899 only.

§The yield for beans is for 1909, 1919, and 1929 only.

LIVESTOCK AND LIVESTOCK PRODUCTS

More dairy cows were reported in 1845 than in any subsequent census year (table 6). The number declined from 9007 in 1845 to 5497 in 1900. Since 1900, the trend in cow numbers has been slightly upward; 6646 were reported in 1935.

In 1854, nearly all of the milk was sold as butter or cheese (table 7). In contrast, in 1929 about 88 per cent was sold as fluid milk or cream and the remaining 12 per cent as butter. During this period, the average sales per cow increased from 2175 to 3135 pounds.

Until 1900, sheep were the most important type of livestock in Yates County (table 6). The number decreased from 130,134 in 1845 to 19,946 in 1935. Farmers have found that in most sections of the county other enterprises are more profitable than sheep-raising. To a large extent, dairy cattle have replaced sheep in the eastern towns; sheep-raising has

TABLE 6. NUMBER OF LIVESTOCK ON FARMS, YATES COUNTY, NEW YORK, 1845 TO 1935*

Year	Dairy cows†	Sheep (all ages)	Swine (all ages)	Chickens‡	Horses (all ages)
	Number	*Number*	*Number*	*Number*	*Number*
1845	9,007	130,134	18,882	......	6,523
1855	7,250	64,827	12,586	......	6,773
1865	6,828	147,397	6,853	......	6,735
1875	6,769	56,384§	11,389	......	7,871
1880	6,636	51,863	9,078	86,611	7,448
1890	5,741	43,120	8,967	91,920	7,962
1900	5,497	49,448	6,507	114,735	7,473
1910	5,566	36,554	7,884	125,644	7,270
1920	6,137	26,213	8,784	133,700	6,368
1925	6,394	24,677	4,420	155,580	5,265
1930	6,048	29,664	3,199	155,109	4,071
1935	6,646	19,946‖	2,580	171,373	....

*Data for 1845 to 1875 are from the New York State Censuses. Data for 1880 to 1935 are from the United States Censuses.

†For the period 1845 to 1890, *dairy cows* includes cows milked or cows kept mainly for milk production; for 1900 to 1935, it includes cows 2 years old or older, except 1930, data for which comprise the number of cows milked in 1929.

‡For 1880, the number of chickens includes poultry on hand June 1, exclusive of spring hatching; for 1890, the data are for domestic fowl (chickens) June 1; and for 1900, the number of fowl 3 months old or older on January 1. From 1900 to 1925, the data are for the total number of chickens on January 1; for 1930 and 1935, the data are for chickens over 3 months old on farms April 1, 1930, and January 1, 1935.

§Number of sheep shorn in 1874.

‖Of this number, 16,563 were ewes 1 year old or older.

TABLE 7. MILK OR CREAM SOLD FROM FARMS OR MANUFACTURED INTO BUTTER OR CHEESE ON FARMS, YATES COUNTY, NEW YORK, 1854, 1874, 1899, AND 1929*

	Milk equivalent†			
	1854	1874	1899	1929
	Pounds	*Pounds*	*Pounds*	*Pounds*
Milk sold‡	108,317	546,814	1,455,713	13,831,070
Cream sold	....	....	198,165	2,931,142
Butter	15,062,439	17,430,588	8,947,596	2,199,834
Cheese	599,720	529,500	42,840	....
Total	15,770,476	18,506,902	10,644,314	18,962,046
	Per cent	*Per cent*	*Per cent*	*Per cent*
Milk sold‡	0.7	3.0	13.7	72.9
Cream sold	....	....	1.9	15.5
Butter	95.5	94.2	84.0	11.6
Cheese	3.8	2.8	0.4	....
Total	100.0	100.0	100.0	100.0
Number of cows milked	7,250	6,769	5,497	6,048
Milk equivalent per cow (pounds)	2,175	2,734	1,936	3,135

*Data for 1854 and 1874 are from New York State Censuses for 1855 and 1875. Data for 1899 and 1929 are from United States Censuses for 1900 and 1930.

†The following factors were used in converting butter, cheese, and cream into equivalent pounds of milk: 1 pound of butter = 21 pounds of milk; 1 pound of cheese = 10 pounds of milk; 1 pound of cream = 10 pounds of milk; 1 pound of butterfat = 25.6 pounds of milk. The following weights were used: 1 gallon of milk was assumed to weigh 8.6 pounds; 1 gallon of cream, 8.25 pounds.

‡Includes milk sold to cheese factories.

declined less in the western part of the county, where there are large areas of land suitable for sheep pasture but not well adapted to crops (figure 6). The sheep are grazed on the hill pastures in the summer months and taken down to the valley farms for feeding during the winter. Hay, grain, bean pods, and waste products are used as feed. Unfavorable milk prices, the supply of otherwise waste feeds, and the nearness to large areas of

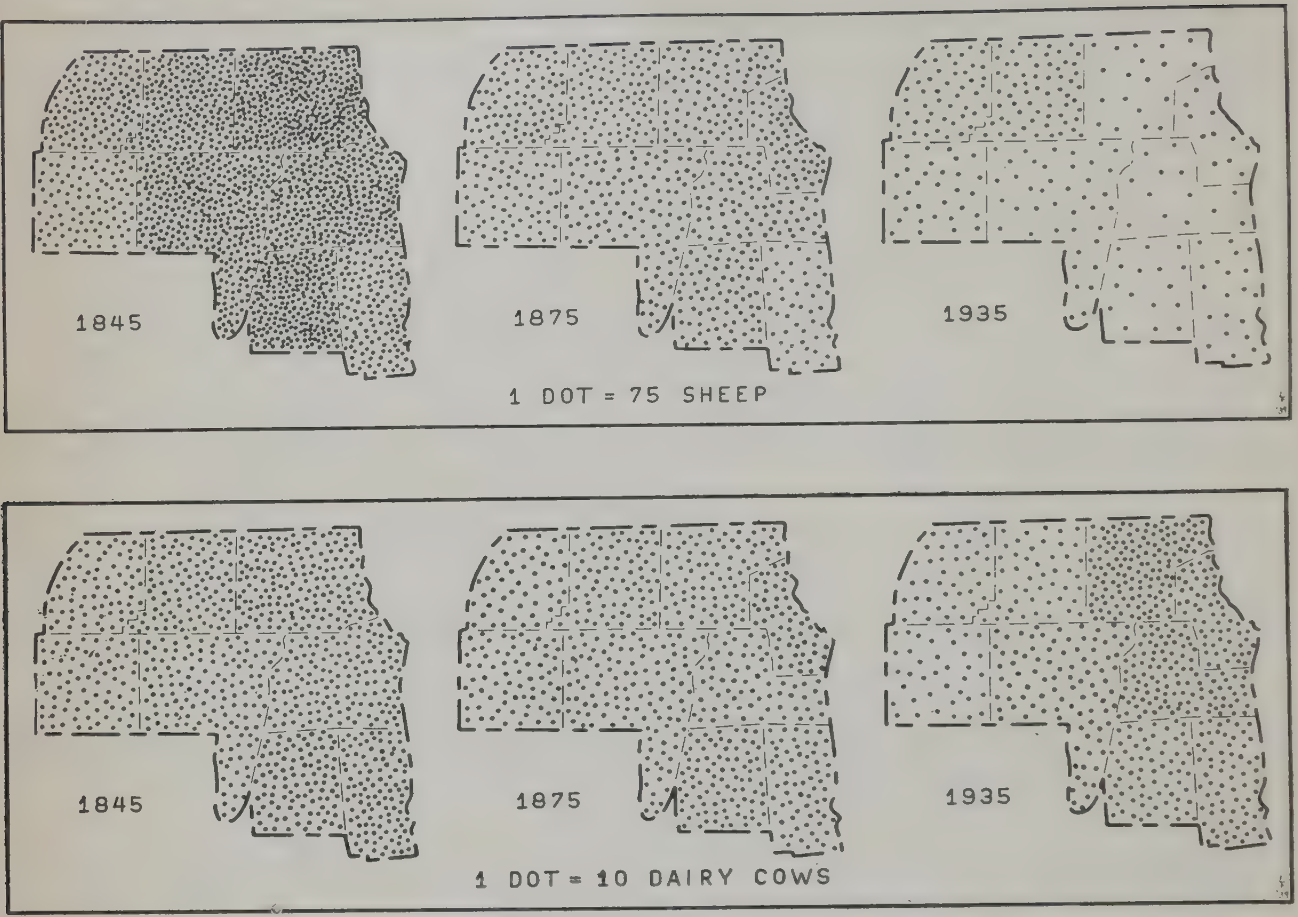

FIGURE 6. LOCATION OF SHEEP AND OF DAIRY COWS IN YATES COUNTY IN 1845, 1875, AND 1935

Dairy cattle have replaced sheep on many farms in the eastern towns, and sheep-raising has shifted to the western part of the county. There has been a large decrease in the number of sheep

land suitable for sheep pasture have retarded the replacement of sheep by dairy cattle in the western towns.

The number of horses on farms declined about 49 per cent from 1890 to 1930, and swine have decreased about 86 per cent since 1845. There were twice as many chickens in 1935 as in 1880.

POPULATION

The population of Yates County increased from 4867 in 1810 to 19,009 in 1825. For the 65-years period following 1825, the total population changed very little. From 1890 to 1930, it decreased from 21,001 to 16,848 (table 8). The rural population has decreased rapidly, while in the villages there has been either an increase or little change.

TYPES OF FARMING IN YATES COUNTY

In 1929, two-fifths of the farms in Yates County were classified by the Census as *general* farms; their incomes came from several enterprises, no one of which made up as much as 40 per cent of the total income. One-fifth of the farms were classified as *fruit* farms and one-tenth as *dairy* farms. Six per cent were classified as *poultry* farms and 6 per cent as *crop-specialty* farms. The remaining 18 per cent included *animal-specialty*, *truck*, *cash-grain*, *self-sufficing*, *abnormal*, and *unclassified* farms.

TABLE 8. POPULATION CHANGES IN THE TOWNS OF YATES COUNTY, NEW YORK, 1855 TO 1930*

Town	1855	1890	1930	Change 1855–1930
	Number	*Number*	*Number*	*Per cent*
Barrington	1,504	1,393	790	–47
Benton†	2,500	2,291	1,845	–26
Italy	1,506	1,206	510	–66
Jerusalem	2,797	2,957	2,072	–26
Middlesex	1,305	1,387	839	–36
Milo†	4,304	6,028	6,561	+52
Potter†	2,148	1,680	1,190	–46
Starkey†	2,428	2,862	2,237	– 8
Torrey†	1,320	1,197	804	–39
Total, Yates County	19,812	21,001	16,848	–15

*Data for 1855 are from the New York State Census. Data for 1890 and 1930 are from the United States Censuses.

†Towns that contain incorporated villages.

AN ECONOMIC CLASSIFICATION OF THE LAND

METHODS AND BASES USED[4]

The land in Yates County was divided into nine land classes, using the following bases:

(1) A land-use map, which shows how the land was used in 1938. This map was prepared by ruling United States Geological Survey sheets into squares of 10 acres each. The use of the land in each square was determined by field observation.

(2) A soil map prepared by the Agronomy Department at Cornell University in cooperation with the Bureau of Chemistry and Soils of the United States Department of Agriculture. The land-use and soil maps are of the same scale, making it possible to study the use of each soil.

(3) A property-classification map made by a roadside inspection of each property in the county. The farms were classified according to the size and condition of the buildings and the apparent amount of farm business being done. Rural residences were classified according to condition and occupancy.

(4) Topography and elevation, which are shown on the United States Geological Survey maps.

(5) Location in respect to markets and marketing facilities.

The results of more than 30 years of farm-management research in New York State were used as a guide in appraising the relative importance of these factors as they affect land use.

DEFINITION OF LAND CLASSES

Land class I. Contains a large proportion of woods and idle land. Most of the farms already have been abandoned. The land is probably best adapted to forests and to recreational uses.

Land class II. Used more intensively than land class I, but contains much idle land and many abandoned farms. The soil, topography and

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[4] A detailed discussion of the methods used in land-use studies is given in *Methods Used in An Economic Study of Land Utilization in Tompkins County, New York, and in Other Similar Studies in New York,* by A. B. Lewis. (Cornell Univ. Agr. Exp. Sta., Memoir 160, 1934.)

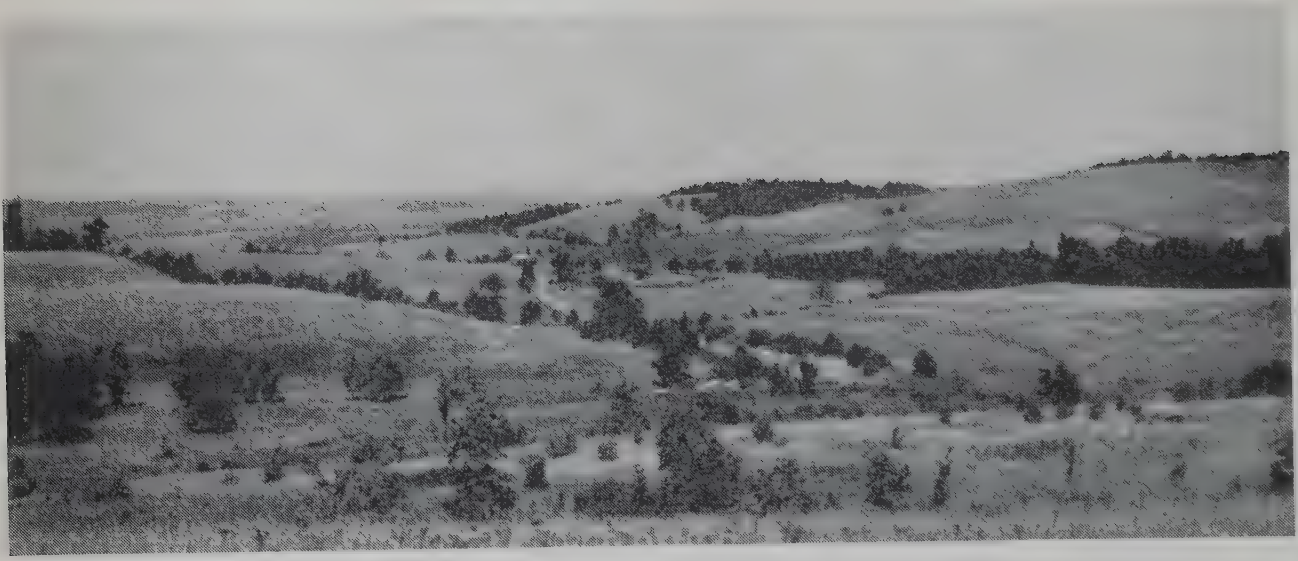


FIGURE 7. AN AREA OF LAND CLASS II

Only about 4 per cent of land class II is used for intertilled crops; 43 per cent is idle or in woods

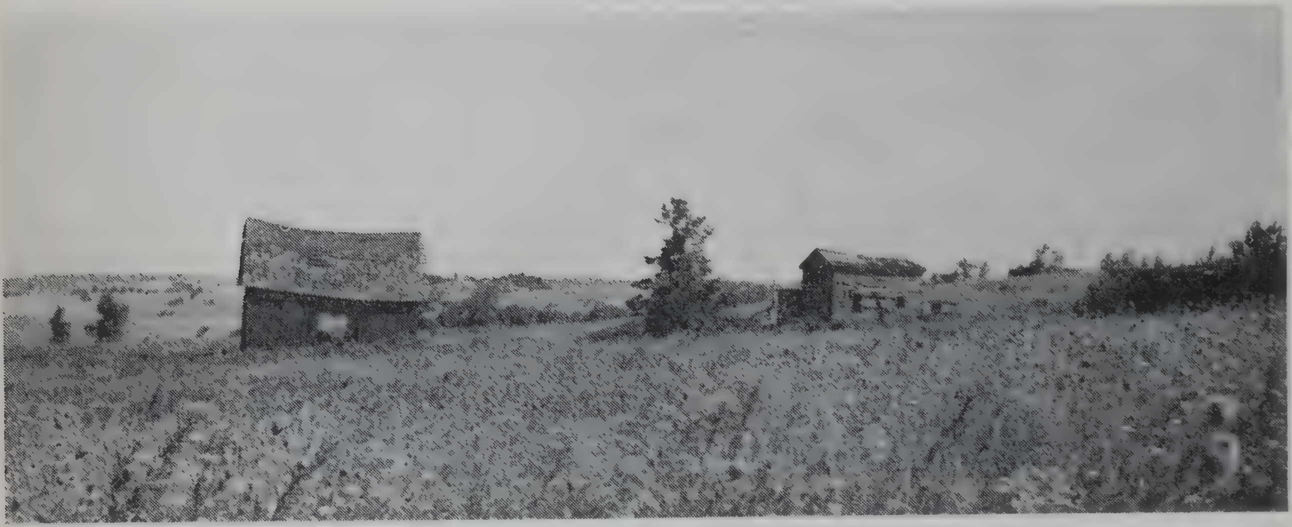


FIGURE 8. AN ABANDONED FARMSTEAD IN LAND CLASS II

Of the houses standing in land class II in 1900, more than one-third had disappeared by 1938

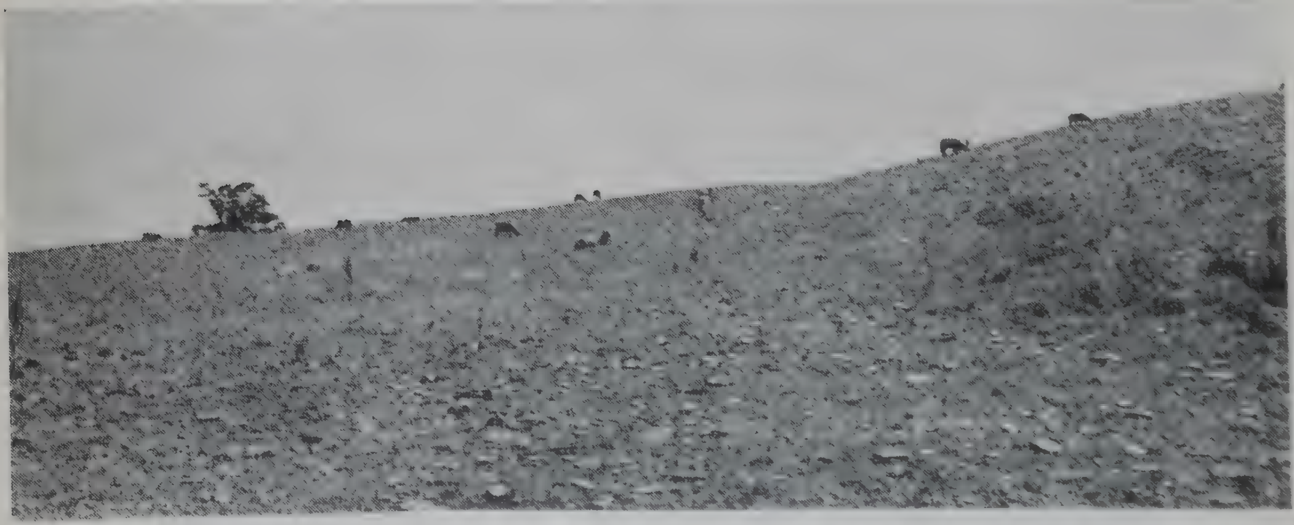


FIGURE 9. SHEEP PASTURE IN LAND CLASS II

Much of land class II is rough and stony. Many of the soils are poorly drained and nearly all of them are deficient in lime

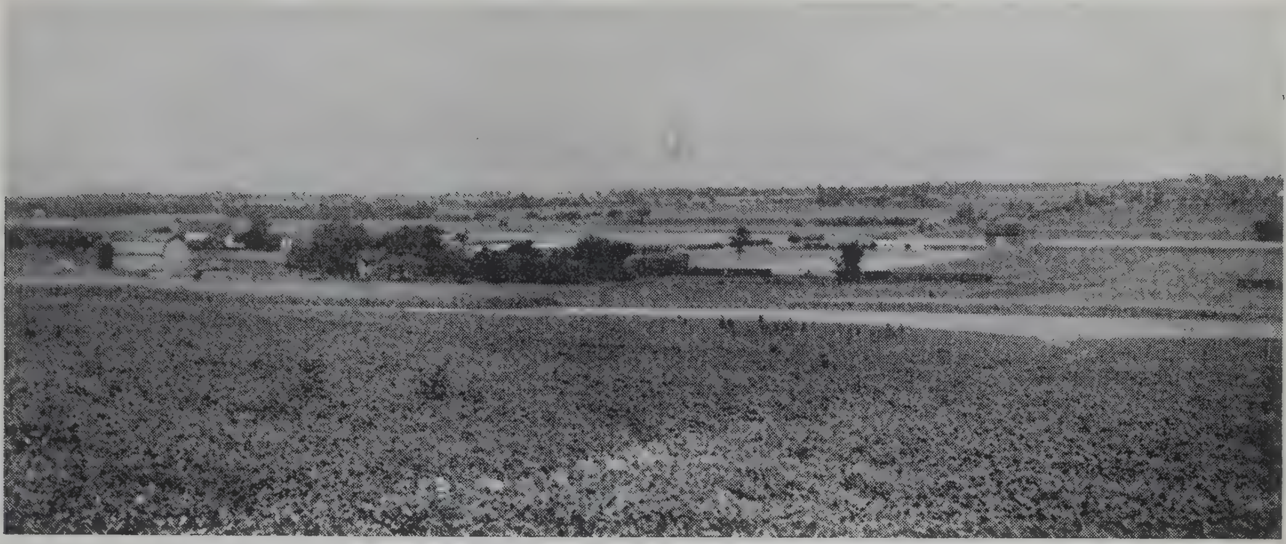


FIGURE 10. AN AREA OF LAND CLASS V NEAR BENTON CENTER

About 29 per cent of land class V is used for intertilled crops; only 5 per cent is idle or in woods

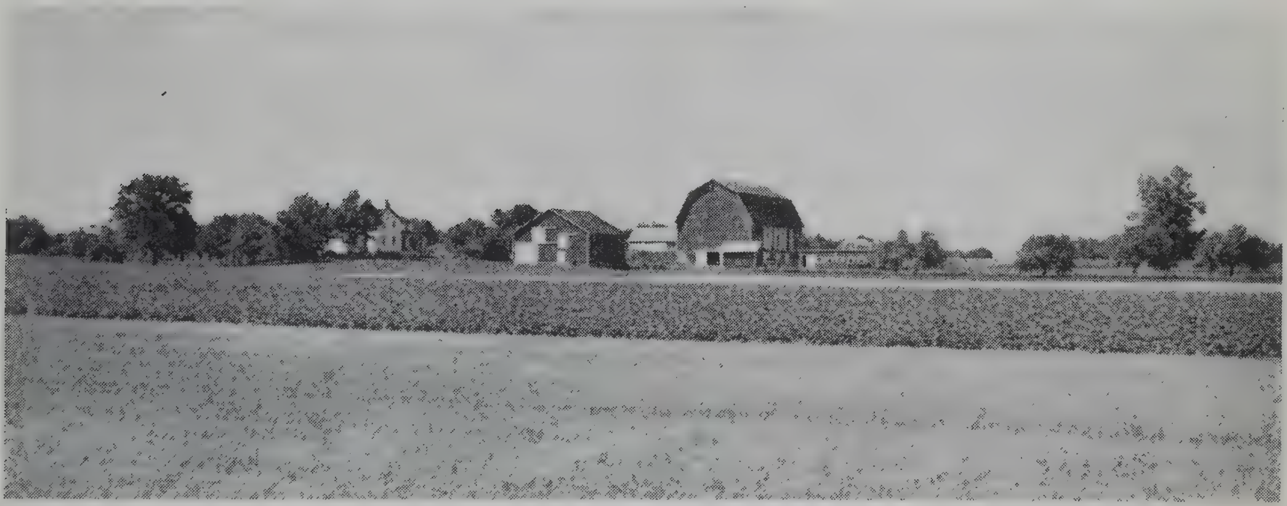


FIGURE 11. A GOOD FARM IN LAND CLASS V

Nearly all of the soils in land class V are well drained and contain lime

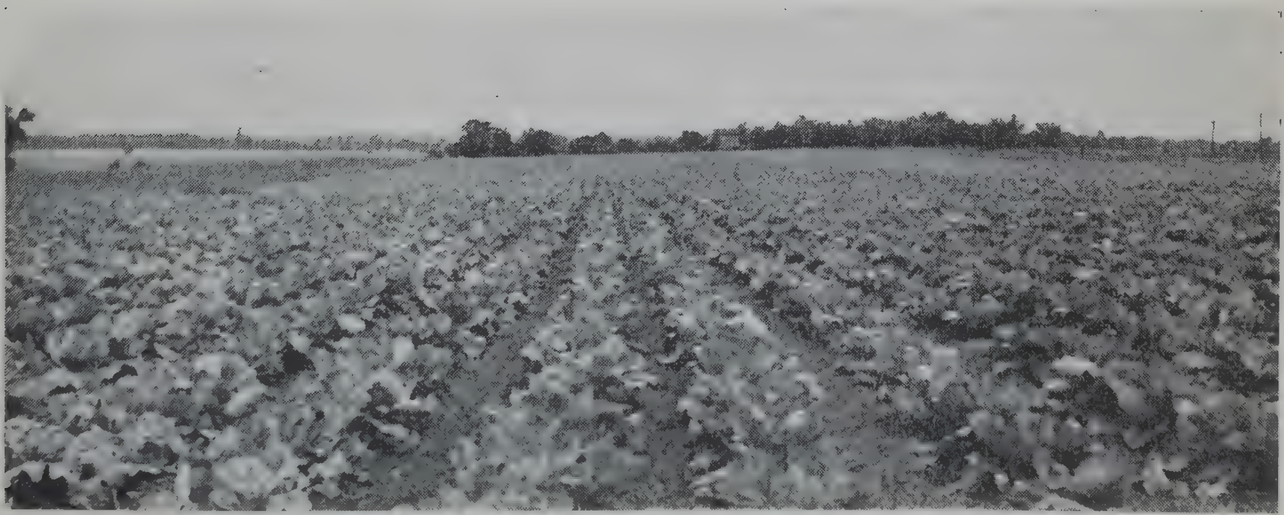


FIGURE 12. A FIELD OF CABBAGE IN LAND CLASS V

More than 4 per cent of land class V was used for cabbage. Cabbage grows best on well-drained soils high in lime elevation, crops grown, size and condition of the farm buildings, and the income records of the farms indicate that most of the land is probably better suited to forests and to recreational uses than to farming. Some of this land is now being used for sheep pasture.

Land classes IR and IIR. Agriculturally the same as land classes I and II, respectively, but probably cannot be purchased at a reforestation price because of their value for residential and private recreational purposes.

Land classes III, IV, and V. Permanent agricultural land. The higher the number, the greater the intensity of land use, and, in general, the more profitable the farming. Land class V is the most intensively used land in Yates County.

Land class IIIR. Agriculturally the same as land class III, but, because it borders Lake Keuka and Canandaigua Lake, it probably will be used for residential and private recreational purposes rather than for farming.

Land class R. Used mostly for residential and commercial purposes.

In placing the boundaries around areas of land classes III, IV, or V an attempt was made to include all the land needed for the efficient operation of the farms likely to remain permanently in agriculture. Therefore, these land classes include some land which is not adapted to crops, but is used for pasture and farm woodlots. Land classes I and II also include entire farms, as well as the unneeded portions of farms in the adjoining higher land classes.

The land classes seldom have distinct boundaries, but grade into one another. The transition area commonly approaches the average of the two adjacent land classes.

The productivity of the land within a land class varies, and the farms are not of equal profitability. There are occasionally unprofitable farms in a good area, but the higher the land class the greater is the proportion of good farms. Some farms in good areas appear poor because of the management, others because of small size. Small areas of productive land are found in land classes I and II, but these areas are not large enough for a profitable farm business.

EXTENT OF EACH LAND CLASS

The extent and location of the different land classes in Yates County are shown in figure 1 and on the large-scale map which accompanies this

TABLE 9. ACREAGE OF LAND IN EACH LAND CLASS, YATES COUNTY, NEW YORK, 1938

Land class	Acres*	Per cent
I	18,647	8.6
II	60,864	28.0
III	81,430	37.5
IV	33,468	15.4
V	9,399	4.3
IR	1,049	0.5
IIR	6,401	2.9
IIIR	2,041	0.9
Residential	4,068	1.9
Total	217,367	100.0

*The United States Census for 1935 reported 219,520 acres as the approximate land area of Yates County. The 217,367 acres mapped on the land-use map comprise 99 per cent of the census figure.

bulletin. Two-fifths of the county is in land classes I, IR, II, and IIR; about two-fifths is in land class III; and about one-fifth is in land classes IV and V (table 9).

The proportion of land in each land class varies widely between towns. Ninety-four per cent of Italy is in land classes I, II, and IIR (table 10). Only 2 per cent of Benton is in these land classes. A large proportion of the land classified as land class II in Italy, Jerusalem, and Middlesex is used for sheep pasture. This land is not adapted to crops and most of the buildings have been abandoned, but probably the land will continue to be used for pasture so long as sheep are kept on farms in the western towns.

TABLE 10. PROPORTION OF THE LAND IN EACH LAND CLASS IN THE TOWNS OF YATES COUNTY, NEW YORK, 1938

Land class	Barrington	Benton	Italy	Jerusalem	Middlesex	Milo	Potter	Starkey	Torrey
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
I	....	....	44	10	4	....	11	....	....
II	60	1	46	40	40	15	26	11	....
III	34	31	6	37	31	41	42	68	62
IV	1	31	....	6	21	30	19	13	28
V	....	35	....	....	....	*	....	....	....
IR	....	....	*	2	1	....	....	....	....
IIR	2	1	4	2	....	4	1	5	8
IIIR	3	....	....	....	2	5	....	....	....
Residential	....	1	....	3	1	5	1	3	2
All land classes	100	100	100	100	100	100	100	100	100
Average land class†	2.4	4.0	1.6	2.4	2.7	3.1	2.7	3.0	3.2
Number of acres in town	22,770	26,792	25,770	37,820	19,925	24,739	23,929	21,147	14,475

*Less than 0.5 per cent.

†The average land class is calculated by multiplying the percentage in each land class by the corresponding land-class number and dividing by the percentage in land classes I to V, inclusive. For example, the average land class for Benton was calculated as follows: $(1 \times 2) + (31 \times 3) + (31 \times 4) + (35 \times 5) + (1 \times 2) = 396 \div 99 = 4.0$.

The average land class probably is one of the best measures of the economic value of the land in a town. The average land class ranges from 1.6 in Italy to 4.0 in Benton. The average for the county is 2.7.

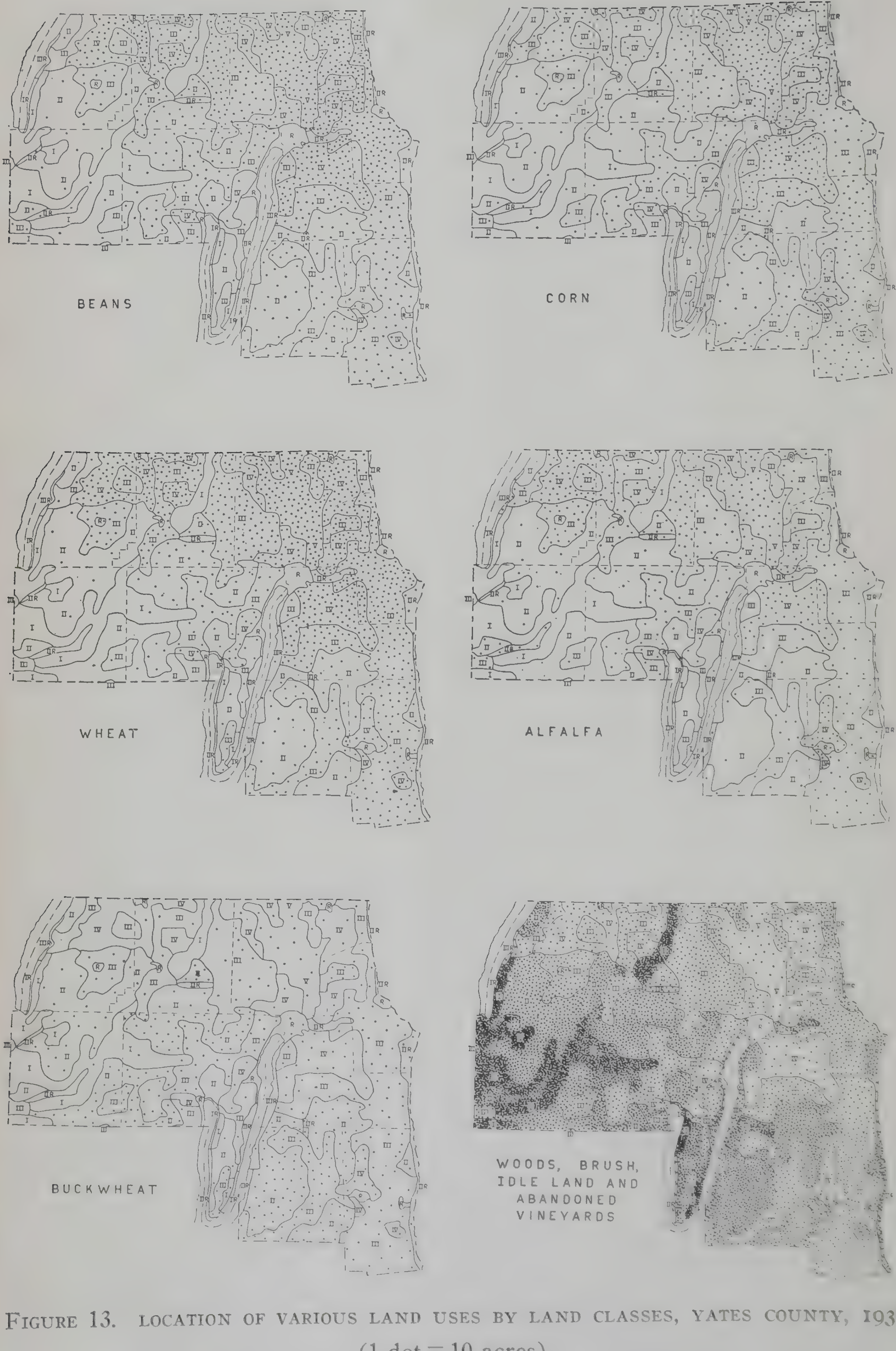
RELATION OF THE BASES OF LAND CLASSIFICATION TO LAND CLASS

Land use

Land use in each land class

Yates County has been settled for about 150 years. During this period, the farmers of the county have attempted to use their land for the most profitable purposes. The present use of the land, resulting from this long period of experimentation, is a valuable aid in classifying the land. It reflects the combined effects of soil, topography, climate, distance to market, and market conditions for farm products.

In land classes I and IR, about 87 per cent of the land was idle or in woods and less than 1 per cent was used for intertilled crops (tables 11 and 12 and figure 13). The higher the land class, the smaller was the proportion of idle land and woods, and the larger the proportion of land used for intensive crops. In land class V, about 29 per cent of the land was in intertilled crops, 26 per cent in small grains, 4 per cent in orchards,



BEANS

CORN

WHEAT

ALFALFA

BUCKWHEAT

WOODS, BRUSH, IDLE LAND AND ABANDONED VINEYARDS

FIGURE 13. LOCATION OF VARIOUS LAND USES BY LAND CLASSES, YATES COUNTY, 1938

(1 dot = 10 acres)

Most of the beans, corn, wheat, and alfalfa are in the higher land classes, while the buckwheat, woods, brush, idle land, and abandoned vineyards are concentrated in land classes I and II and 15 per cent in hay. Only 5 per cent was idle or in woods. The more intensive crops, which are largely in the higher land classes, include truck crops, cabbage, beans, and corn. Most of the better vineyards are in land class IV.

TABLE 11. USE OF LAND IN EACH LAND CLASS, YATES COUNTY, NEW YORK, 1938

Use of land	Acreage in land class						Total
	I and IR*	II and IIR†	III and IIIR‡	IV	V	Residential§	
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Idle land	5,660	12,778	5,416	699	108	300	24,961
Woods and brush	11,380	15,511	11,933	2,436	358	190	41,808
Abandoned vineyard	69	632	203	19	0	21	944
Total idle land and woods	17,109	28,921	17,552	3,154	466	511	67,713
Permanent pasture	372	5,453	11,783	4,397	1,194	239	23,438
Sheep pasture	856	10,545	3,687	267	33	0	15,388
Brush pasture	49	1,349	2,371	450	83	7	4,309
Rotated pasture	0	30	230	228	192	8	688
Total pasture	1,277	17,377	18,071	5,342	1,502	254	43,823
Alfalfa	7	505	2,808	2,112	590	126	6,148
Clover	10	885	3,933	2,572	559	47	8,006
Timothy	9	846	3,310	1,166	207	47	5,585
Old meadow¶	46	1,503	2,374	330	15	39	4,307
Very old meadow**	170	3,567	1,869	260	17	7	5,890
Total hay	242	7,306	14,294	6,440	1,388	266	29,936
Spring grains††	75	2,090	6,230	3,351	1,092	69	12,907
Wheat	13	842	5,548	3,713	1,219	18	11,353
Rye	2	589	386	57	16	8	1,058
Buckwheat	57	2,060	2,038	425	127	8	4,715
Total small grains	147	5,581	14,202	7,546	2,454	103	30,033
Beans (dry)	14	1,402	5,156	3,479	1,047	47	11,145
Corn	20	967	3,714	2,496	979	48	8,224
Potatoes	18	213	243	132	53	12	671
Cabbage	0	11	114	243	415	0	783
Canning-factory peas	0	63	243	190	86	4	586
Truck crops‡‡	1	34	103	151	110	64	463
Berries	2	73	332	123	9	8	547
Total intertilled crops	55	2,763	9,905	6,814	2,699	183	22,419
Orchard§§:							
Bearing	0	147	917	893	377	98	2,432
Nonbearing	0	8	43	11	2	1	65
Vineyard:							
Good	17	385	1,578	1,163	18	45	3,206
Fair	83	745	1,596	263	0	42	2,729
Poor	0	316	288	28	0	13	645
Nonbearing	15	29	123	26	0	0	193
Total orchard and vineyard	115	1,630	4,545	2,384	397	199	9,270
Miscellaneous‖‖	751	3,687	4,902	1,788	493	2,552	14,173
Total	19,696	67,265	83,471	33,468	9,399	4,068	217,367

*There are 1049 acres of IR, of which 340 acres were used for *miscellaneous* purposes.

†There are 6401 acres of IIR, of which 1449 acres were used for *miscellaneous* purposes.

‡There are 2041 acres of IIIR, of which 565 acres were used for *miscellaneous* purposes.

§Includes commercial and industrial property.

‖Includes 251 acres of sweet clover and 12 acres of millet.

¶Hay in which most of the clover has been killed. Weeds and native grasses make up a large part of the vegetation.

**Hay that is mostly weeds and native grasses. In many years, only parts of the fields are mowed. Fields not mowed are included under *idle land*.

††Includes oats, barley, and mixed grains.

‡‡Includes 264 acres of farm gardens.

§§Abandoned orchards that were pastured are included with *pasture*.

‖‖Includes farmsteads, roads, railroads, streams, cemeteries, recreational grounds, and rural areas used for residential or commercial purposes.

TABLE 12. PROPORTION OF THE LAND USED FOR VARIOUS PURPOSES IN EACH LAND CLASS, YATES COUNTY, NEW YORK, 1938

Use of land	Land class						All land classes
	I and IR*	II and IIR*	III and IIIR*	IV	V	Residential*	
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Idle land	28.7	19.0	6.5	2.1	1.2	7.4	11.5
Woods and brush	57.8	23.1	14.3	7.2	3.8	4.7	19.2
Abandoned vineyard	0.4	0.9	0.2	0.1	0	0.5	0.4
Total idle land and woods	86.9	43.0	21.0	9.4	5.0	12.6	31.1
Permanent pasture	1.9	8.1	14.1	13.1	12.7	5.9	10.8
Sheep pasture	4.4	15.7	4.4	0.8	0.4	0	7.1
Brush pasture	0.2	2.0	2.8	1.4	0.9	0.2	2.0
Rotated pasture	0	†	0.3	0.7	2.0	0.2	0.3
Total pasture	6.5	25.8	21.6	16.0	16.0	6.3	20.2
Alfalfa	†	0.8	3.4	6.3	6.3	3.1	2.8
Clover*	0.1	1.3	4.7	7.7	5.9	1.1	3.7
Timothy	†	1.3	4.0	3.5	2.2	1.1	2.6
Old meadow*	0.2	2.2	2.8	1.0	0.2	1.0	2.0
Very old meadow*	0.9	5.3	2.2	0.7	0.2	0.2	2.7
Total hay	1.2	10.9	17.1	19.2	14.8	6.5	13.8
Spring grains*	0.4	3.1	7.5	10.0	11.6	1.7	5.9
Wheat	†	1.2	6.6	11.1	13.0	0.4	5.2
Rye	†	0.9	0.5	0.2	0.2	0.2	0.5
Buckwheat	0.3	3.1	2.4	1.3	1.3	0.2	2.2
Total small grains	0.7	8.3	17.0	22.6	26.1	2.5	13.8
Beans (dry)	0.1	2.1	6.2	10.4	11.1	1.1	5.1
Corn	0.1	1.4	4.5	7.5	10.4	1.2	3.8
Potatoes	0.1	0.3	0.3	0.4	0.6	0.3	0.3
Cabbage	0	†	0.1	0.7	4.4	0	0.4
Canning-factory peas	0	0.1	0.3	0.6	0.9	0.1	0.3
Truck crops*	†	0.1	0.1	0.4	1.2	1.6	0.2
Berries	†	0.1	0.4	0.4	0.1	0.2	0.2
Total intertilled crops	0.3	4.1	11.9	20.4	28.7	4.5	10.3
Orchard*:							
Bearing	0	0.2	1.1	2.6	4.0	2.4	1.1
Nonbearing	0	†	0.1	†	†	†	†
Vineyard:							
Good	0.1	0.6	1.9	3.5	0.2	1.1	1.5
Fair	0.4	1.1	1.9	0.8	0	1.1	1.3
Poor	0	0.5	0.4	0.1	0	0.3	0.3
Nonbearing	0.1	†	0.1	0.1	0	0	0.1
Total orchard and vineyard	0.6	2.4	5.5	7.1	4.2	4.9	4.3
Miscellaneous*	3.8	5.5	5.9	5.3	5.2	62.7	6.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*See footnotes to table 11.
†Less than 0.05 per cent.

Land use in each town

The intensity to which the land is used in each town is indicated by the proportion used for different purposes. For example, more than 40 per cent of the land in Benton and Torrey was used for intertilled crops and small grains, while in Italy only 5.7 per cent was used for these crops (table 13). In Jerusalem, 8.7 per cent of the land was in orchards and vineyards. A large proportion of the vineyards in the county are in Jerusalem. Pasture, largely for sheep, made up more than 20 per cent of the area in Barrington, Middlesex, and Potter. The proportion of the

Figure 14. a field of beans in land class V
About 11 per cent of land class V is used for beans

TABLE 13. Use of Land in Each Town, Yates County, New York, 1938

Town	Use of land							All uses	Acres in town
	Idle land, woods, and brush	Pasture	Hay	Small grains	Inter-tilled crops	Orchard and vine-yard	Other uses		
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Acres*
Barrington	36.9	20.4	13.8	12.6	7.0	3.9	5.4	100.0	22,770
Benton	14.2	18.6	13.9	22.7	21.9	2.9	5.8	100.0	26,792
Italy	62.7	18.5	8.5	3.9	1.8	0.6	4.0	100.0	25,770
Jerusalem	37.8	17.8	12.5	10.3	5.7	8.7	7.2	100.0	37,820
Middlesex	28.3	30.2	14.6	9.6	6.2	5.2	5.9	100.0	19,925
Milo	19.3	18.3	14.6	17.4	14.1	6.2	10.1	100.0	24,739
Potter	28.1	25.3	14.6	15.0	11.7	1.1	4.2	100.0	23,929
Starkey	24.7	18.9	18.4	14.4	10.4	4.7	8.5	100.0	21,147
Torrey	18.5	14.7	16.0	22.9	17.7	2.2	8.0	100.0	14,475
All towns	31.1	20.2	13.8	13.8	10.3	4.3	6.5	100.0	217,367

land that was idle, or in woods and brush, ranged from 14.2 per cent in Benton to 62.7 per cent in Italy.

Soils

The topography of the land and the drainage, depth, and lime content of the soils determine to a great extent the agricultural value of land.

The soils in Yates County were grouped according to drainage and lime content. About two-thirds of the soils are well drained and one-third are imperfectly or poorly drained (table 14). About one-third of the soils contain lime; one-fourth are both well drained and high in lime.

Soils in each land class

In the higher land classes, a large proportion of the soils contain lime and have good natural drainage. For example, in land class V, 89.4 per

TABLE 14. SOIL COMPOSITION OF EACH LAND CLASS, YATES COUNTY, NEW YORK, 1938*

Soil type	Proportion of land class						Average land class of soil†	Acres in soil‡
	I and IR	II and IIR	III and IIIR	IV	V	I–V		
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*		*Acres*
Well-drained:								
With lime:								
Ontario loam	0.5	2.7	22.5	51.0	59.9	20.4	3.6	43,250
Ontario fine sandy loam (a)	0.1	0.8	4.5	14.0	29.2	5.5	3.8	11,645
Ontario gravelly fine sandy loam	0.4	....	0.9	1.5	0.3	0.6	3.3	1,379
Total	1.0	3.5	27.9	66.5	89.4	26.5	3.6	56,274
Without lime (deep):								
Chenango fine sandy loam	....	§	0.8	....	....	0.3	3.0	668
Chenango gravelly fine sandy loam	0.1	§	0.7	0.4	0.2	0.3	3.2	735
Chenango gravelly silt loam	0.7	2.6	4.0	2.5	1.0	2.9	2.8	6,145
Wooster silt loam	1.8	5.4	9.8	9.4	....	7.2	2.9	15,237
Wooster gravelly silt loam	3.8	5.8	7.5	2.9	0.2	5.6	2.6	11,846
Wooster fine sand	0.1	0.2	0.4	0.5	0.1	0.3	3.0	724
Total	6.5	14.0	23.2	15.7	1.5	16.6	2.8	35,355
Without lime (shallow):								
Wooster stony silt loam (b)	11.3	10.4	3.3	0.9	....	5.8	2.1	12,246
Lordstown silt loam (c)	....	0.9	3.2	0.4	....	1.6	2.9	3,414
Lordstown stony silt loam	46.2	19.6	4.9	0.5	....	12.4	1.8	26,383
Total	57.5	30.9	11.4	1.8	....	19.8	2.0	42,043
Imperfectly drained (with lime):								
Ontario loam, smooth phase (d)	....	....	0.5	2.1	3.0	0.7	3.9	1,417
Ontario loam, shallow phase (e)	....	§	0.8	0.7	....	0.4	3.2	908
Schoharie silty clay	0.2	1.0	4.4	1.1	0.2	2.2	2.9	4,746
Total	0.2	1.0	5.7	3.9	3.2	3.3	3.2	7,071
Poorly drained (without lime):								
Allis silt loam	0.3	1.4	1.0	§	....	0.9	2.4	1,856
Holly silt loam	....	0.1	0.2	....	....	0.1	2.7	281
Papakating silt loam	....	....	0.1	0.4	3.8	0.3	4.5	585
Papakating silty clay loam	0.4	0.6	0.2	§	....	0.3	2.2	669
Volusia silt loam (f)	4.4	24.8	18.9	6.2	§	16.6	2.5	35,197
Volusia silt loam, flat phase (g)	....	1.2	2.5	2.7	....	1.8	3.0	3,773
Volusia stony silt loam	12.3	18.4	4.0	0.1	....	8.5	2.1	18,068
Volusia silty clay loam	0.2	0.3	0.9	0.3	....	0.5	2.9	1,007
Total	17.6	46.8	27.8	9.7	3.8	29.0	2.4	61,436
Miscellaneous soils:								
Genesee silt loam (h)	0.5	1.5	1.6	1.2	1.2	1.4	2.8	3,000
Muck	16.5	1.1	1.2	1.1	0.9	2.5	1.8	5,419
Rough, stony land	0.2	1.2	1.2	0.1	....	0.9	2.5	1,836
All miscellaneous soils	17.2	3.8	4.0	2.4	2.1	4.8	2.2	10,255
All soils	100.0	100.0	100.0	100.0	100.0	100.0	2.7	212,434
Acres in each land class	19,583	66,968	83,136	33,371	9,376	212,434		

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*The data on soils are from *Soil Survey of Yates County, New York*, by E. T. Maxon (U. S. Agr. Dept., Bur. Chem. and Soils), 1918. The grouping of the soils and the footnotes (a) to (h) below giving more recent soil names, none of which appear on the Yates County soil map, were adapted from suggestions by F. B. Howe and C. S. Pearson of the Agronomy Department at Cornell University.

†For the method used in calculating the average land class, see footnote to table 10.

‡Does not include areas classified as residential or the acreage in streams.

§Less than 0.05 per cent.

(a) Includes some Groton gravelly sandy loam, particularly in the area west of Benton Center.

(b) Includes some Bath gravelly silt loam.

(c) Includes some Angola silt loam.

(d) More recently designated as Lyons silt loam.

(e) More recently designated as Lansing silt loam, shallow phase.

(f) Includes some Canfield silt loam at the lower elevations.

(g) The areas mapped as Volusia silt loam and Volusia silt loam, flat phase, south of Dresden and north of Himrod are Hilton silt loam and Hilton silt loam, flat phase, respectively. These are better-drained soils than Volusia and are better adapted to crops.

(h) Most of the areas in Yates County that are mapped as Genesee silt loam are either imperfectly or poorly drained. The imperfectly drained areas would now be mapped as Eel silt loam and the poorly drained areas as Wayland silt loam.

cent of the soils are well drained and contain lime, while in land classes I and IR only 1.0 per cent have both good drainage and lime (table 14). In land classes II and IIR, 91.7 per cent of the soils are deficient in lime and 47.8 per cent are imperfectly or poorly drained.

Of the 26 soil types mapped in Yates County, Ontario loam, Lordstown stony silt loam, and Volusia silt loam have the largest areas. Ontario loam is a well-drained soil containing lime. Nearly all of it is in the higher land classes. About 60 per cent of land class V is Ontario loam. Lordstown stony silt loam is a well-drained soil, but is deficient in lime. Most of the Lordstown soil is in the lower land classes, because it is shallow, stony, low in lime, and rough. Volusia silt loam is poorly drained and low in lime. In general, it is not adapted to intensive crops and is mainly in the lower land classes.

Occasionally there are small areas of poorly drained soils in the higher land classes. For example, all of the Papakating silt loam, a poorly drained soil deficient in lime, is in land classes III, IV, and V. There are only 585 acres of this soil type in the county. Because all of it is surrounded by highly productive soils, it is used mainly for pasture, meadow, and woodlots.

The method of mapping soils has been improved since the soil map for Yates County was made. Some of the soils have been regrouped and designated by new names. In a few places in the county the soils are better drained, higher in lime, and of greater agricultural value than is indicated by the soil map. This accounts for the Volusia silt loam in land class IV north of Himrod. The soil in this area would now be mapped as Hilton silt loam.

The average land class of a soil probably is the best single measure of its economic value (see footnote to table 10 for method of calculation). The average land class of the well-drained soils with lime is 3.6, as compared with 2.4 for the poorly drained soils without lime (table 14). For Ontario loam, the average land class is 3.6; for Lordstown stony silt loam, 1.8; and for Volusia silt loam, 2.5.

Intensity of use of different soils

The drainage, lime content, and depth of the soils, and the topography of the land, determine to a large extent what crops can be grown profitably. Most farmers have adjusted their cropping practices to meet these soil and topographic conditions. Soils that are adapted to intensive crops have proved to be most profitable in New York State.

A soil is used intensively when a high proportion of its area is in intertilled crops, grapes, and the better-quality hay crops, such as alfalfa and clover. It is not used intensively if most of its area is in woods, idle land, and pasture.

Of the well-drained soils containing lime, about one-half of the acreage was in intertilled crops, orchard, vineyard, and small grains (table 15). Twelve per cent was in alfalfa and clover, 10 per cent in beans, and 1.2 per cent in cabbage. About 14 per cent was idle or in woods.

Of the poorly drained soils without lime, only about 25 per cent of the acreage was in intertilled crops, orchard, vineyard, and small grains (table 16). Eight per cent was in alfalfa, clover, beans, and cabbage. About one-third was idle or in woods.

Use of land	With lime			All well-drained soils with lime	Without lime									
					Deep						Shallow			All well-drained soils without lime
	Ontario loam	Ontario fine sandy loam	Ontario gravelly fine sandy loam		Chenango fine sandy loam	Chenango gravelly fine sandy loam	Chenango gravelly silt loam	Wooster silt loam	Wooster gravelly silt loam	Wooster fine sand	Wooster stony silt loam	Lordstown silt loam	Lordstown stony silt loam	
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Idle land	3.9	2.7	3.9	3.7	13.5	7.5	8.1	6.8	15.5	10.3	20.8	10.0	12.4	12.3
Woods and brush	9.9	10.9	15.3	10.1	7.4	8.9	12.7	14.4	16.0	24.0	19.8	12.9	52.5	29.6
Total idle land and woods	13.8	13.6	19.2	13.8	20.9	16.4	20.8	21.2	31.5	34.3	40.6	22.9	64.9	41.9
Pasture	16.7	15.6	14.6	16.5	18.6	17.3	10.9	19.3	24.6	15.5	21.8	25.5	17.8	19.3
Alfalfa	5.9	4.0	2.8	5.5	2.3	1.1	9.9	3.7	3.5	4.3	1.6	2.6	0.4	2.5
Clover	6.5	6.8	2.3	6.5	1.5	14.5	2.3	7.2	3.7	4.6	2.8	5.3	0.2	3.1
Timothy	2.3	1.9	0.9	2.2	4.8	0	4.8	5.0	3.1	0	1.6	6.7	0.5	2.5
Old meadow	1.6	0.3	0.6	1.4	3.1	5.6	2.6	2.0	3.1	3.0	1.7	0.7	0.9	1.7
Very old meadow	0.8	0.4	0	0.7	0	1.9	2.2	1.9	3.2	0	3.6	2.0	2.0	2.4
Total hay	17.1	13.4	6.6	16.3	11.7	23.1	21.8	19.8	16.6	11.9	11.3	17.3	4.0	12.2
Spring grains	9.4	8.4	21.1	9.4	7.4	6.1	6.2	8.2	6.5	6.7	4.3	6.0	1.3	4.5
Wheat	9.8	12.6	12.4	10.3	2.5	1.1	2.9	7.1	4.3	7.6	2.6	6.2	0.7	3.3
Rye	0.2	0.2	0	0.2	0	0	1.3	0.1	0.1	0	0.7	0.1	0.3	0.4
Buckwheat	1.1	0.7	0	1.0	0	0.6	1.1	2.0	1.5	0	3.3	2.7	0.4	1.4
Total small grains	20.5	21.9	33.5	20.9	9.9	7.8	11.5	17.4	12.4	14.3	10.9	15.0	2.7	9.6
Beans (dry)	9.9	10.6	7.3	10.0	0	0	3.7	6.6	2.8	4.6	3.5	6.6	0.4	3.0
Corn	6.5	7.4	4.5	6.6	11.2	2.5	4.7	4.7	3.3	3.3	1.4	2.3	0.7	2.5
Potatoes	0.3	0.3	0	0.4	0	0.3	0.2	0.4	0.7	0.6	0.7	0.1	0.1	0.3
Cabbage	1.1	1.9	0	1.2	0	0	0	0.1	0	0.9	0	0	0	†
Canning-factory peas and truck crops	0.9	1.2	0	0.9	3.3	0.6	0.4	0.3	0.3	2.1	0.1	0.1	†	0.2
Berries	0.2	0.1	0	0.2	1.3	0.5	1.1	0.5	0.3	0	0	0.1	0.1	0.3
Total intertilled crops	18.9	21.5	11.8	19.3	15.8	3.9	10.1	12.6	7.4	11.5	5.7	9.2	1.3	6.3
Orchard	2.3	3.0	0.3	2.4	11.4	2.0	0.2	1.5	0.6	0.6	0.6	0.5	0.5	0.8
Vineyard	4.4	1.3	0.8	3.8	0.5	0.8	2.3	2.8	1.5	4.6	2.2	3.5	5.7	3.6
Total orchard, vineyard	6.7	4.3	1.1	6.2	11.9	2.8	2.5	4.3	2.1	5.2	2.8	4.0	6.2	4.4
Miscellaneous	6.3	9.7	13.2	7.0	11.2	28.7	22.4	5.4	5.4	7.3	6.9	6.1	3.1	6.3
All uses	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total acres (thousands)	44.0	12.4	1.5	57.9	0.7	0.9	7.1	15.6	12.1	0.7	12.2	3.4	26.4	79.1

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*To tabulate the use of each soil, the soil map was ruled into squares of 10 acres each, which coincided with those on the land-use map. Only those squares containing but one soil type were tabulated. Hence, this table does not include the total acreage of well-drained soils in the county.

†Less than 0.05 per cent.

TABLE 16. PERCENTAGE OF IMPERFECTLY AND POORLY DRAINED SOILS IN EACH USE, YATES COUNTY, NEW YORK, 1938*

Use of land	Imperfectly drained (with lime)			All imperfectly drained soils	Poorly drained (without lime)								All poorly drained soils	All imperfectly and poorly drained soils
	Ontario loam, smooth phase	Ontario loam, shallow phase	Schoharie silty clay		Volusia silt loam	Volusia silt loam, flat phase	Allis silt loam	Holly silt loam	Papakating silt loam	Papakating silty clay loam	Volusia stony silt loam	Volusia silty clay loam		
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Idle land	0	28.7	10.2	12.1	15.3	5.0	8.9	14.6	8.3	19.5	27.5	0.6	17.8	17.2
Woods and brush	19.2	0.7	11.1	10.1	14.0	14.0	26.0	5.6	3.7	6.0	19.1	16.8	15.5	15.0
Total idle land and woods	19.2	29.4	21.3	22.2	29.3	19.0	34.9	20.2	12.0	25.5	46.6	17.4	33.3	32.2
Pasture	25.4	2.4	23.4	20.8	20.2	22.8	24.4	41.6	31.5	47.0	24.3	32.8	21.8	21.7
Alfalfa	0	5.5	2.5	2.8	1.0	3.0	1.5	0	0	0	0.5	0	1.0	1.1
Clover	7.9	3.7	1.5	2.1	3.3	7.6	0.7	5.6	9.3	0	1.2	3.0	2.9	2.8
Timothy	0	1.5	4.3	3.7	3.2	4.6	3.0	12.4	17.6	0	1.2	2.7	2.8	2.9
Old meadow	0	1.8	4.1	3.7	4.3	1.9	6.8	0	0	0	2.7	0	3.7	3.7
Very old meadow	0	3.6	2.0	2.1	5.8	4.2	0	0	0	6.7	6.0	4.2	5.6	5.3
Total hay	7.9	16.1	14.4	14.4	17.6	21.3	12.0	18.0	26.9	6.7	11.6	9.9	16.0	15.8
Spring grains	7.3	5.5	7.3	7.1	6.7	6.8	3.3	0	8.3	0	2.4	3.9	5.4	5.6
Wheat	6.2	0	6.4	7.3	4.0	7.7	2.3	0	0	0	1.1	9.0	3.4	3.8
Rye	0	13.9	0.2	0.2	1.4	0	1.5	0	0	0	0.8	0	1.1	1.0
Buckwheat	2.3	2.4	1.1	1.3	5.4	3.1	0.9	3.4	9.3	4.0	3.7	0.6	4.7	4.4
Total small grains	15.8	21.8	15.0	15.9	17.5	17.6	8.0	3.4	17.6	4.0	8.0	13.5	14.6	14.8
Beans (dry)	17.0	21.2	2.9	5.7	4.6	10.3	0	6.7	0	6.0	1.6	10.5	4.0	4.2
Corn	11.3	3.5	2.8	3.2	3.5	4.0	1.9	9.0	0	0.7	1.3	6.9	3.0	3.0
Potatoes	0	0	0.1	0.1	0.2	0	0	0	0	0	0.1	0.3	0.2	0.2
Cabbage	0	0.7	0	0.1	†	0.6	0	0	5.5	0	0	0.3	0.1	0.1
Canning-factory peas and truck crops	0	0.5	0.2	0.2	0.5	0.2	0	0	3.7	0	0.1	0	0.3	0.3
Berries	0	0	0.1	0.1	0.1	0	0	0	0	0	0.2	0	0.1	0.1
Total intertilled crops	28.3	25.9	6.1	9.4	8.9	15.1	1.9	15.7	9.2	6.7	3.3	18.0	7.7	7.9
Orchard	0	0.2	0.5	0.4	0.7	0.8	0.3	0	0	8.1	†	0	0.5	0.5
Vineyard	0	0	4.8	4.1	1.7	0.3	14.9	0	0	0	2.4	2.4	2.1	2.3
Total orchard and vineyard	0	0.2	5.3	4.5	2.4	1.1	15.2	0	0	8.1	2.4	2.4	2.6	2.8
Miscellaneous	3.4	4.2	14.5	12.8	4.1	3.1	3.6	1.1	2.8	2.0	3.8	6.0	4.0	4.8
All uses	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total acres (thousands)	1.4	0.9	5.2	7.5	35.3	3.8	1.9	0.3	0.6	0.7	18.1	1.0	61.7	69.2

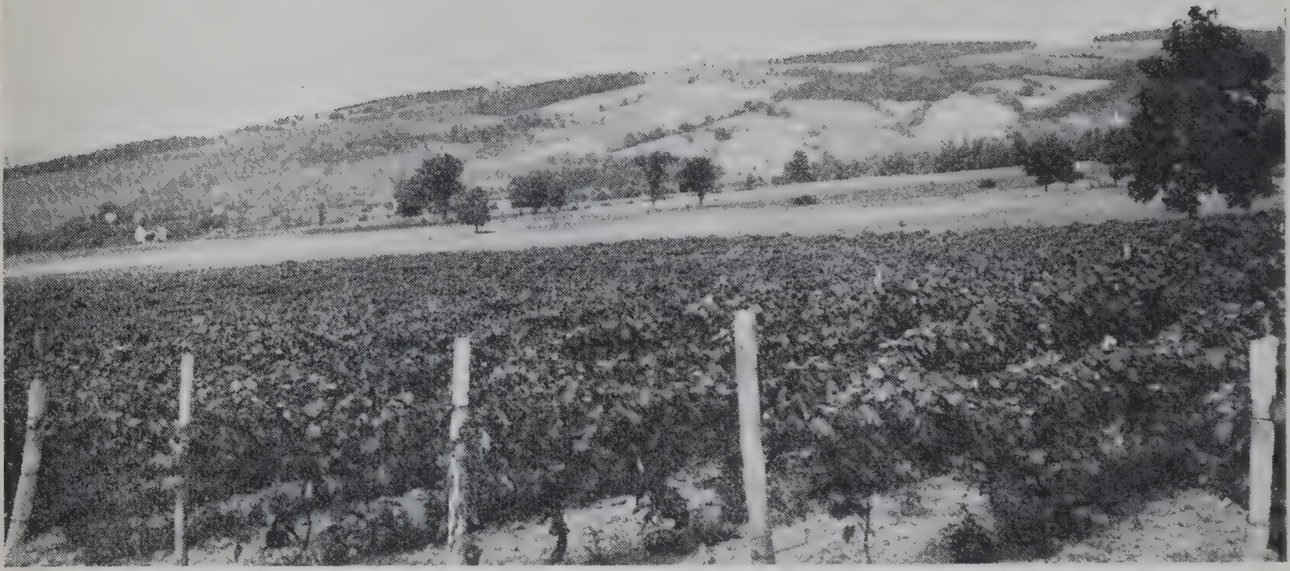

FIGURE 15. GRAPES IN LAND CLASS IV

Most of the high-producing vineyards are in land class IV

Intensity of use in each land class

In classifying land, factors other than soil characteristics are considered. These include topography, elevation, and nearness to bodies of water. Since soils are not the only basis for classifying land, a soil type may occur in more than one land class. Likewise, the purposes for which a

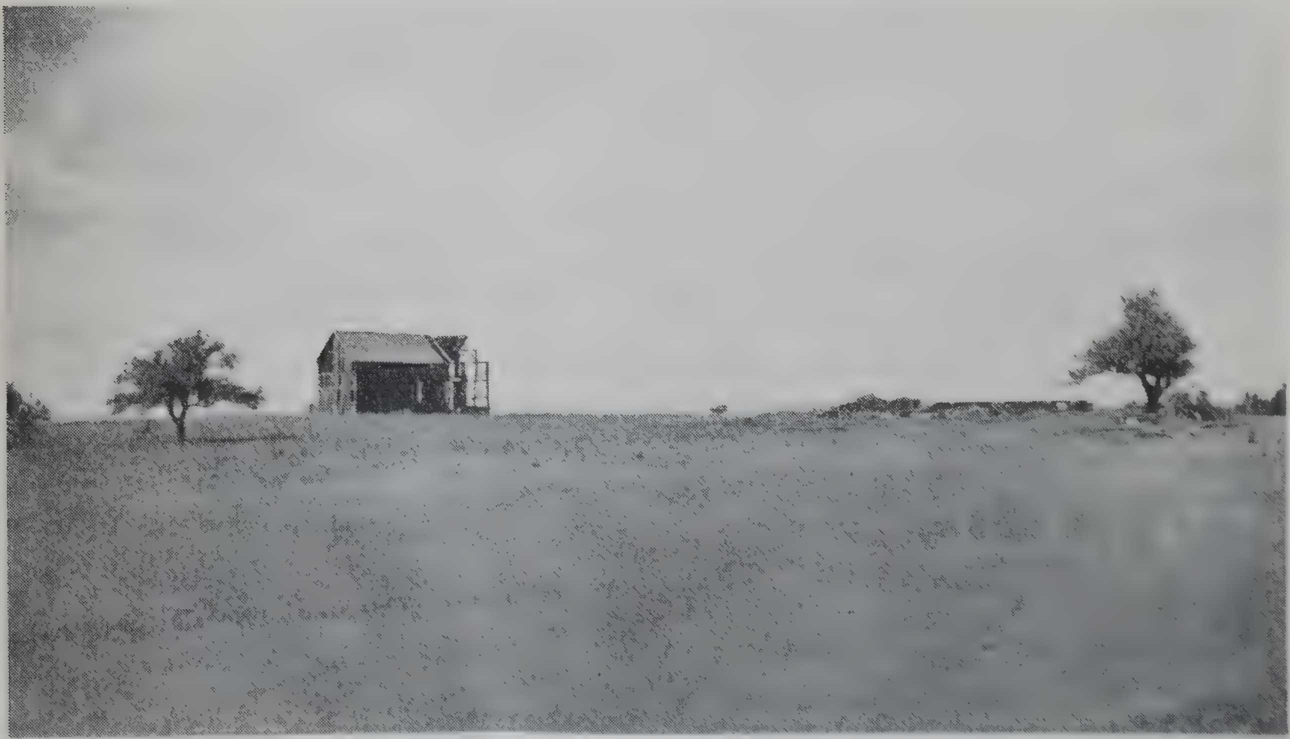

FIGURE 16. AN AREA OF LAND CLASS II

The farmstead has been abandoned, but the land is used for sheep pasture. About 16 per cent of land class II is used for this purpose soil type is used may vary widely between land classes. For example, Wooster stony silt loam, a well-drained soil, occurs in large areas in land classes I and II. Here it is not used intensively because of shallowness, rough topography, and high elevation. In land classes I and IR, only 1.4 per cent was used for intertilled crops, orchard, and vineyard; in land classes III and IIIR, 13.6 per cent, and in land class IV, 42.5 per cent, was used for these purposes (table 17). In land classes I and IR, 79.7 per cent of this soil type was idle or in woods, as compared with only 18.1 per cent in land class IV (table 18).

TABLE 17. Proportion of the Acreage of Each Soil Type in Intertilled Crops, Orchard, and Vineyard, Yates County, New York, 1938

Soil type	Land class				
	I and IR	II and IIR	III and IIIR	IV	V
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Well-drained:					
With lime:					
Ontario loam	*	5.3	22.1	29.0	34.2
Ontario fine sandy loam (a)	....	16.2	16.2	28.2	41.0
Ontario gravelly fine sandy loam	*	....	8.4	26.8	....
Average	*	6.7	21.0	28.8	36.1
Without lime (deep):					
Chenango fine sandy loam	....	....	27.7	....	....
Chenango gravelly fine sandy loam	....	....	7.8	*	....
Chenango gravelly silt loam	*	6.1	18.6	14.0	*
Wooster silt loam	0	10.4	16.1	25.6	....
Wooster gravelly silt loam	4.8	4.5	12.4	13.1	....
Wooster fine sand	....	*	17.6	*	....
Average	3.5	7.3	15.8	22.1	*
Without lime (shallow):					
Wooster stony silt loam (b)	1.4	6.8	13.6	42.5	....
Lordstown silt loam (c)	....	10.3	11.7	*	....
Lordstown stony silt loam	0.1	7.6	26.6	*	....
Average	0.3	7.4	18.5	51.4	....
Imperfectly drained (with lime):					
Ontario loam, smooth phase (d)	....	....	*	*	*
Ontario loam, shallow phase (e)	....	....	23.7	35.0	....
Schoharie silty clay	*	9.2	9.7	38.5	....
All imperfectly drained soils	*	9.2	11.7	35.8	*
Poorly drained (without lime):					
Volusia silt loam (f)	0	7.5	14.3	29.0	....
Volusia silt loam, flat phase (g)	....	1.2	15.6	26.1	....
Allis silt loam	*	17.8	17.5	....	....
Holly silt loam	....	*	*	....	....
Papakating silt loam	....	....	....	....	9.3
Papakating silty clay loam	....	*	*	....	....
Volusia stony silt loam	1.8	4.0	17.5	*	....
Volusia silty clay loam	*	*	22.8	*	....
All poorly drained soils	1.4	6.4	15.0	27.9	9.3
Miscellaneous:					
Genesee silt loam (h)	*	2.5	13.2	*	....
Muck	0	0	2.2	*	....
Rough, stony land	....	0	0	....	....
All miscellaneous soils	0	0.9	5.8	23.7	....
All soils	0.6	6.7	17.2	28.2	35.5

*Less than 100 acres of the soil type.
For footnotes (a) to (h) see corresponding footnotes to table 14.

TABLE 18. PROPORTION OF THE ACREAGE OF EACH SOIL TYPE IN WOODS, BRUSH, IDLE LAND, AND ABANDONED VINEYARDS, YATES COUNTY, NEW YORK, 1938

Soil type	Land class				
	I and IR	II and IIR	III and IIIR	IV	V
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Well-drained:					
With lime:					
Ontario loam	*	37.6	19.3	8.3	4.3
Ontario fine sandy loam (a)	....	40.0	20.2	12.2	6.7
Ontario gravelly fine sandy loam	*	....	22.6	10.5	....
Average	*	37.9	19.5	9.0	4.9
Without lime (deep):					
Chenango fine sandy loam	....	....	20.9	....	....
Chenango gravelly fine sandy loam	....	....	22.4	*	....
Chenango gravelly silt loam	*	38.1	21.2	15.3	*
Wooster silt loam	66.5	28.1	23.3	8.3	....
Wooster gravelly silt loam	62.2	46.1	20.6	13.9	....
Wooster fine sand	....	*	24.6	*	....
Average	63.1	37.5	22.2	10.1	*
Without lime (shallow):					
Wooster stony silt loam (b)	79.7	36.5	24.0	18.1	....
Lordstown silt loam (c)	....	61.3	18.1	*	....
Lordstown stony silt loam	91.5	51.7	35.7	*	....
Average	89.8	47.3	27.2	10.2	....
Imperfectly drained (with lime):					
Ontario loam, smooth phase (d)	....	....	*	*	*
Ontario loam, shallow phase (e)	....	....	35.1	8.5	....
Schoharie silty clay	*	28.9	22.5	1.0	....
All imperfectly drained soils	*	28.9	24.2	8.5	*
Poorly drained (without lime):					
Volusia silt loam (f)	85.8	39.7	17.3	5.1	....
Volusia silt loam, flat phase (g)	....	32.8	23.8	1.9	....
Allis silt loam	*	56.4	14.9	....	....
Holly silt loam	....	*	*	....	....
Papakating silt loam	....	....	....	....	12.0
Papakating silty clay loam	....	*	*	....	....
Volusia stony silt loam	86.0	42.3	25.9	*	....
Volusia silty clay loam	*	*	13.1	*	....
All poorly drained soils	85.8	40.7	18.5	4.1	12.0
Miscellaneous:					
Genesee silt loam (h)	*	47.3	25.9	*	....
Muck	99.3	90.8	83.7	*	....
Rough, stony land	....	76.2	75.8	....	....
All miscellaneous soils	99.3	71.0	58.1	47.4	....
All soils	89.9	42.8	21.3	9.0	5.0

*Less than 100 acres of the soil type.
For footnotes (a) to (h) see corresponding footnotes to table 14.

Most of the other soil types were used more intensively in the higher land classes than in land classes I and II. Of the 1178 acres of Ontario loam in land classes II and IIR for which the use was tabulated, only 5.3 per cent was in intertilled crops, orchard, and vineyard. In land class V, 34.2 per cent of this soil type was used for these purposes. Other important soil types such as Lordstown stony silt loam and Volusia silt loam also were used more intensively in the higher land classes.

Within each land class, most of the well-drained soils were used more intensively than were soils imperfectly or poorly drained. Likewise, soils containing lime were used for more intensive purposes than were soils deficient in lime.

Classification of rural properties

In an area that has been settled as long as has Yates County, the occupancy, size, and condition of farm buildings indicate the productivity of the land and the past profits from farming.

To provide one of the bases for classifying the land in Yates County, the farms along each road were classified in 1938 according to size, condition, and the apparent amount of farm business being done. The occupied farms were classified as *very good, good, fair,* or *poor;* the rural residences, as *good* or *poor.* Tenant houses on farms were classified as rural residences. Each place that had an occupied house and a barn that was being used was classified as a farm. In some cases there was more than one complete set of buildings on land operated by one person.

Of the houses that were standing in 1900, when the United States Geological Survey maps were made, 56 per cent of those in land class I and 37 per cent of those in land class II had disappeared or were falling by 1938 (table 19). Only 9 per cent of those in land class V were gone or falling. Of the habitable farm houses, 10 per cent were vacant in land class I and 11 per cent in land class II, but only 5 per cent in land class V. Since one man can farm more acres than formerly, fewer houses are needed; therefore, even in the higher land classes, some buildings are vacant or have disappeared. In land classes I and II, the large areas of idle land indicate that farms have been abandoned rather than consolidated.

In 1934, in connection with a preliminary survey to locate the areas of

TABLE 19. PROPORTION OF PROPERTIES OCCUPIED, VACANT, AND GONE OR FALLING IN EACH LAND CLASS, YATES COUNTY, NEW YORK, 1938

Class of property	Land class								Average
	I	II	III	IV	V	IR	IIR	IIIR	
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Farms:									
Occupied	10	33	51	59	57	...	25	50	45
Vacant	10	11	6	3	5	...	4	...	6
Rural residences:									
Occupied	6	8	14	19	18	9	23	17	15
Vacant	13	7	4	3	4	6	8	6	4
Camps*	1	...	†	...	...	74	20	6	2
Commercial establishments, churches, and schools:									
Used	3	3	4	4	6	...	5	4	4
Unused	1	1	†	...	1	...	†	...	1
Houses gone or falling‡	56	37	21	12	9	11	15	17	23
Total	100	100	100	100	100	100	100	100	100
Number of properties	79	794	1,511	635	202	35	267	52	3,575

*Does not include all of the camps and cottages along the lakes, particularly in land classes IIR and IIIR.

†Less than 0.5 per cent.

‡Those that had disappeared since the United States Geological Survey maps were made in 1900.

land classes I and II in New York State, the rural properties in the southern towns of the county were classified in the same way as in 1938. Between 1934 and 1938 the proportion of occupied houses in land classes I and II decreased from 53 to 47 per cent (table 20).

TABLE 20. PROPORTION OF HOUSES OCCUPIED, VACANT, AND GONE OR FALLING, LAND CLASSES I AND II, YATES COUNTY, NEW YORK, 1934 AND 1938

Property classification*	1934		1938		Percentage change 1934 to 1938
	Number	*Per cent*	*Number*	*Per cent*	*Per cent*
Occupied	315	53	280	47	−11
Vacant	92	15	121	20	+32
Gone or falling	191	32	197	33	+ 3
All properties	598	100	598	100	

*Includes only those properties classified as *farms* or *rural residences*, both in 1934 and in 1938. Properties classified as *gone or falling* are those that had disappeared or become uninhabitable since the United States Geological Survey maps were made in 1900.

In the higher land classes most of the occupied farms were classified as *fair* or better (table 21). In land classes I and II, more than one-half of the farms were classified as *poor*.

TABLE 21. CLASSIFICATION OF OCCUPIED FARMS* IN EACH LAND CLASS, YATES COUNTY, NEW YORK, 1938

Farm class	Land class							All land classes
	I	II	III	IV	V	IIR	IIIR	
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Very good	...	...	1	2	7	...	...	1
Good	...	2	13	29	39	3	19	16
Fair	25	40	66	56	48	52	62	58
Poor	75	58	20	13	6	45	19	25
Total	100	100	100	100	100	100	100	100
Number of farms†	8	260	764	377	116	66	26	1,617

*In the counties previously studied, where dairying is more important than in Yates County, there are in the higher land classes larger proportions of farms classified as *good* and *very good*. In Yates County, where cash-crop farming is important, the size and condition of buildings is not so indicative of returns from farming as in dairy areas.

†There were no occupied farms in land class IR.

Occupied properties per square mile

In the higher land classes, not only was there a larger proportion of the better farms and rural residences, but they were also closer together. In land class I there was only 0.3 occupied farm per square mile, as compared with 7.9 per square mile in land class V (table 22). The number of farms per square mile is a measure of the intensity of land use. The greater density of occupied properties enables more persons to be served by each mile of road and each mile of electric and telephone line. It reduces the cost per capita of mail delivery, transportation of school children, and provision of other public and private services. It also permits better community organization.

TABLE 22. NUMBER OF OCCUPIED PROPERTIES PER SQUARE MILE IN EACH LAND CLASS, YATES COUNTY, NEW YORK, 1938

Land class	Area	Occupied properties	Occupied properties per square mile				
			Farms	Rural residences	Commercial establishments, schools, and churches	Camps and cottages*	Total*
	Square miles	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
I	29.14	16	0.3	0.2	0.1	†	0.6
II	95.10	349	2.7	0.7	0.3	....	3.7
III	127.23	1,037	6.0	1.6	0.5	....	8.1
IV	52.29	526	7.2	2.3	0.5	....	10.0
V	14.69	164	7.9	2.5	0.8	....	11.2
IR	1.64	29	...	1.8	...	15.9	17.7
IIR	10.00	195	6.6	6.2	1.3	5.4	19.5
IIIR	3.19	40	8.2	2.8	0.6	0.9	12.5
Total or average	333.28	2,356	4.9	1.5	0.4	0.3	7.1

*Does not include all the camps and cottages along the lakes, particularly in land classes IIR and IIIR.
†Less than 0.05 per square mile.

Elevation

In New York State, land at the higher elevations usually is not well adapted to farming.[5] Commonly, the topography is rough, the soil shallow, stony, and poorly drained, and the growing season shorter than at the lower elevations. For these reasons, most of the land at the higher elevations is in the lower land classes. In Yates County, nearly one-half of land class I is 1550 feet or more in elevation (table 23 and figure 17). Potter Swamp comprises most of the land class I occurring below 950 feet. In land classes IV and V, practically none of the land is above 1249 feet. Most of the land in classes IR, IIR, and IIIR is along the lakes where the elevation is below 950 feet.

TABLE 23. PROPORTION OF EACH LAND CLASS AT DIFFERENT ELEVATIONS, YATES COUNTY, NEW YORK, 1938*

Elevation	Land class								
	I	II	III	IV	V	IR	IIR	IIIR	I–V
Feet	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Below 950	22	12	35	51	48	100	50	97	32
950–1249	10	25	45	46	52	0	39	3	38
1250–1549	22	35	18	3	0	0	11	0	19
Above 1549	46	28	2	0	0	0	0	0	11
Total	100	100	100	100	100	100	100	100	100

*Includes only privately owned land recorded on the tax rolls.

RELATION OF OTHER FACTORS TO LAND CLASS

Real-estate values

A comparison of the real-estate values in the various land classes serves as a check on the classification of the farms and on the classification of the

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[5] There are several exceptions to this general rule. For example, in Wyoming County, 46 per cent of land class IV and 20 per cent of land class V are 1500 feet or more above sea level.

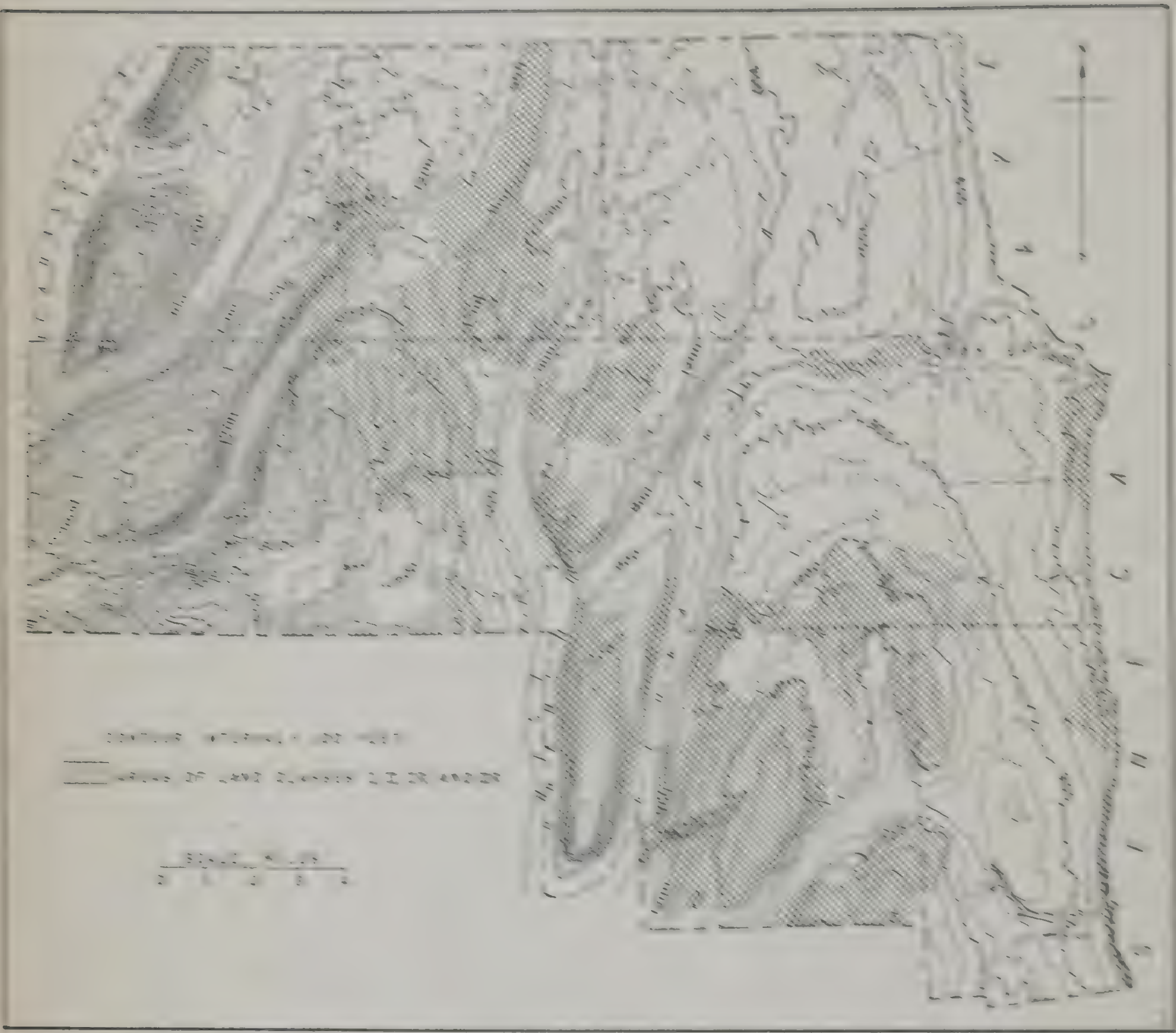
CONTOUR INTERVAL 100 FEET
AREAS OF LAND CLASSES I, II, IR AND IIR
SCALE IN MILES
0 1 2 3 4

FIGURE 17. TOPOGRAPHIC MAP OF YATES COUNTY

Most of the better farming land is at the lower elevations. Nearly one-half of land class I is more than 1550 feet above sea level

land. Since tax assessments are the only valuations that are easily available and that cover the entire county, they were used for this purpose. The assessment rolls were copied and the assessed values raised to full values by dividing by the equalization rate fixed by the State Tax Commission. With the aid of town assessors, the properties were located on maps. Since land classification is concerned primarily with rural lands, only parcels of five acres or more were considered.

Valuation of real estate in each land class

The average full value per acre of land and buildings was $20 in land class I and $30 in land class II, as compared with $91 per acre in land class V (table 24). Land classes I and II made up 30.1 per cent of the acreage appearing on the tax rolls, but only 6.5 per cent of the full value of all properties (figure 18). Land class V comprised 4.9 per cent of the acreage and 3.4 per cent of the full value.

Because most of the land in classes IR, IIR, and IIIR borders the lakes and contains many cottages and residences, the value of land and buildings per acre is relatively high. The average value per acre of land and buildings in land class IIIR was $124.

Full value of each class of farm

The full value per acre of land and buildings varied from an average of $47 for farms classified as *poor* to an average of $89 for those classified as *very good* (table 25). The *very good* farms averaged more than twice as many acres as did the *poor* farms.

Division of the tax base in each town according to types of property

The full value of all types of property that formed the tax base for Yates County was $27,234,706 in 1937 (tables 24 and 26). Classified land comprised 41.5 per cent of the total; public utilities, 9.6 per cent; and other property, 48.9 per cent. The property exempt from taxation amounted to approximately $4,393,000.[6]

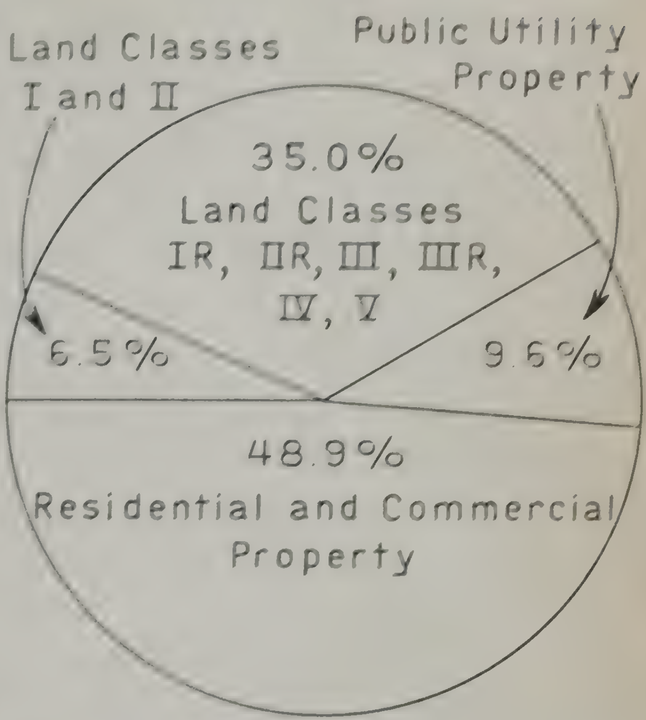

FIGURE 18. DIVISION OF THE TAX BASE, YATES COUNTY, 1937

Land classes I and II made up 30 per cent of the acreage appearing on the tax rolls, but only 6.5 per cent of the value of all property in the county

In towns with incorporated villages, residential and commercial property made up a large proportion of the tax base. The commercial and residential property in Penn Yan made up 69.2 per cent of the tax base

TABLE 24. ACREAGE AND VALUATION OF THE DIFFERENT LAND CLASSES AND OF OTHER PROPERTY, YATES COUNTY, NEW YORK, 1937

Land class	Acreage	Full value of land and buildings per acre	Total full value*	Percentage of total full value	Percentage of total acres	Ratio of percentage of acres to percentage of value
	Acres	*Dollars*	*Dollars*	*Per cent*	*Per cent*	
I	7,487	20	148,269	0.5	3.6	7.2
II	54,437	30	1,634,348	6.0	26.5	4.4
III	79,808	60	4,821,377	17.7	38.9	2.2
IV	36,480	80	2,934,399	10.8	17.8	1.6
V	10,062	91	916,082	3.4	4.9	1.4
IR	962	91	87,123	0.3	0.5	1.7
IIR	8,370	65	547,536	2.0	4.1	2.0
IIIR	1,701	124	211,181	0.8	0.8	1.0
Other property outside incorporated villages†	2,958	...	5,848,551	21.5	1.4	...
Incorporated villages	3,002	...	10,085,840	37.0	1.5	...
Total	205,267‡	...	27,234,706	100.0	100.0	...

*Full value is the assessed value divided by the equalization rates for the towns, as reported by the New York State Tax Commission for 1937.

†Includes railroads, public utilities, commercial and industrial property, and all parcels of less than five acres.

‡Acreage reported by the New York State Tax Commission for 1937. This includes only those properties appearing on the tax rolls. It does not include 1771 acres of state reforestation land and 1732 acres of federal land.

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[6] *Annual Report of the State Tax Commission, 1937.*

TABLE 25. FULL VALUE PER ACRE OF EACH CLASS OF FARM, YATES COUNTY, NEW YORK, 1937

Class of farm	Farms	Acres per farm	Full value per farm	Full value per acre
	Number	*Number*	*Dollars*	*Dollars*
Occupied:				
Very good	17	158	14,105	89
Good	270	115	8,845	77
Fair	906	81	5,328	66
Poor	362	65	3,023	47
Vacant	196	76	3,443	45
Total or average	1,751	83	5,268	63

of Milo. Public-utility and special-franchise property formed 28.5 per cent of the tax base in Torrey, but only 1.7 per cent in Potter and 4.9 per cent in Jerusalem.

The percentage of the total full value represented by land classes I and II was 68 per cent in Italy and 30 per cent in Barrington; in all other towns it was less than 15 per cent. For the county as a whole, land classes I and II made up only 6.5 per cent of the tax base. The removal of all of land classes I and II from the tax base would not greatly reduce the county tax receipts, but would affect seriously the receipts of the towns of Italy and Barrington.

Farm Bureau membership and participation in the 1939 Agricultural Conservation Program[7]

Of the classified farms in land classes I and II, 31 per cent were operated by Farm Bureau members, as compared with 46 per cent of those in land classes III, IV, and V (table 27). Sixty-five per cent of the Farm Bureau members participated in the 1939 Agricultural Conservation Program, but only 15 per cent of the nonmembers participated. In each land class, the proportion of nonmembers who participated was low, but the proportion of members who participated was relatively high.

Seventy-nine per cent of the farms classified as very good and 60 per cent of those classified as good were operated by Farm Bureau members; only 26 per cent of the farms classified as poor were operated by members (table 28). Eighty per cent of the members on farms classified as very good participated in the 1939 Agricultural Conservation Program, while only 58 per cent of the members on poor farms participated. For each class of farm a much higher proportion of the Farm Bureau members than of nonmembers participated in the 1939 program.

School costs

In Yates County, the cost of education per pupil in one-teacher school districts is much higher in land classes I and II than in land classes III, IV, and V (table 29). In 1936-37, districts entirely in the higher land classes spent, on the average, slightly more per school than did districts in land classes I and II; but since there were about twice as many pupils

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[7] Data furnished by William D. Allen, county agent. In 1939 there were 812 Farm Bureau members who were farmers. Not all of these were on properties classified as farms.

TABLE 26. DIVISION OF THE TAX BASE ACCORDING TO PROPERTY TYPES IN THE TOWNS OF YATES COUNTY, NEW YORK, 1937*

Type of property	Barrington	Benton	Italy	Jerusalem	Middlesex	Milo	Potter	Starkey	Torrey	Yates County
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Outside incorporated villages:										
Classified land:†										
Land class I	......	......	14.2	1.5	0.2	......	1.2	......	......	0.5
Land class II	30.2	0.3	53.6	11.8	14.7	1.2	11.7	1.9	......	6.0
Land class III	34.3	13.8	11.6	24.8	25.7	6.0	36.1	29.8	29.9	17.7
Land class IV	1.2	21.8	......	7.3	25.8	6.4	19.5	9.6	21.0	10.8
Land class V	......	29.6	......	......	......	0.1	......	......	......	3.4
Land class IR	......	......	......	1.9	1.5	......	......	......	......	0.3
Land class IIR	5.4	......	13.5	4.5	......	0.7	4.1	1.9	2.7	2.0
Land class IIIR	5.8	......	......	......	3.8	0.8	......	......	......	0.8
Total	76.9	65.5	92.9	51.8	71.7	15.2	72.6	43.2	53.6	41.5
Public utilities:‡										
Railroads	......	6.7	4.7	......	4.3	2.4	......	9.1	22.7	4.6
Light, heat, power, and water	7.2	3.5	......	3.7	1.2	1.5	0.6	1.5	3.2	2.3
Telephone and telegraph	1.8	1.4	2.0	1.2	0.7	0.3	0.3	0.5	0.8	0.7
Total	9.0	11.6	6.7	4.9	6.2	4.2	0.9	11.1	26.7	7.6
Other rural property§	14.1	13.8	0.4	43.3	22.1	7.9	3.5	10.8	3.7	13.9
Total property outside incorporated villages	100.0	90.9	100.0	100.0	100.0	27.3	77.0	65.1	84.0	63.0
Inside incorporated villages:										
Public utilities:‡										
Railroads	......	0.3	......	......	......	1.0	0.2	1.7	0.5	0.7
Light, heat, power, and water	......	0.1	......	‖	......	1.9	0.5	1.0	1.2	1.0
Telephone and telegraph	......	0.1	......	‖	......	0.6	0.1	0.2	0.1	0.3
Total	......	0.5	......	‖	......	3.5	0.8	2.9	1.8	2.0
Other village property	......	8.6	......	......	......	69.2	22.2	32.0	14.2	35.0
Total property inside incorporated villages	......	9.1	......	‖	......	72.7	23.0	34.9	16.0	37.0
Total, all property	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Value (in thousands)	$1,243	$3,056	$523	$3,611	$1,246	$11,017	$1,434	$3,436	$1,669	$27,235

*Based on full value, which is the assessed value divided by the equalization rate of the towns, as reported by the New York State Tax Commission for 1937.

†Includes only properties recorded on the tax roll.

‡Includes special-franchise property.

§Includes residences in hamlets, commercial and industrial establishments outside incorporated villages, and all types of property of less than 5 acres. Does not include exempt properties.

‖Less than 0.05 per cent.

TABLE 27. RELATION OF LAND CLASS TO FARM BUREAU MEMBERSHIP AND PARTICIPATION IN THE 1939 AGRICULTURAL CONSERVATION PROGRAM, YATES COUNTY, NEW YORK

Land class	Classified farms	Percentage Farm Bureau members	Percentage of Farm Bureau members participating in 1939 program	Percentage of nonmembers participating in 1939 program
	Number	*Per cent*	*Per cent*	*Per cent*
I	8	38	33	20
II	260	30	65	14
I and II	268	31	63	14
III	764	43	65	18
IV	377	51	67	16
V	116	47	64	13
III, IV, and V	1,257	46	65	17
IIR	66	23	60	8
IIIR	26	27	57	11
Residential	52	25	54	0
Total or average	1,669	41	65	15

TABLE 28. RELATION OF CLASSIFICATION OF FARMS TO FARM BUREAU MEMBERSHIP AND PARTICIPATION IN THE 1939 AGRICULTURAL CONSERVATION PROGRAM, YATES COUNTY, NEW YORK

Farm classification	Farms	Percentage Farm Bureau members	Percentage of Farm Bureau members participating in 1939 program	Percentage of nonmembers participating in 1939 program
	Number	*Per cent*	*Per cent*	*Per cent*
Very good	19	79	80	50
Good	272	60	66	26
Fair	967	42	65	14
Poor	411	26	58	14
Total or average	1,669	41	65	15

TABLE 29. CURRENT EXPENSES PER PUPIL IN ONE-TEACHER SCHOOL DISTRICTS IN DIFFERENT LAND CLASSES, YATES COUNTY, NEW YORK, 1936–37

Percentage of district in land classes I and II	School districts*	Children 1–18 years old in school district	Average daily attendance per school	Average current expenses per school†	Average current expenses per pupil†
Per cent	*Number*	*Number*	*Number*	*Dollars*	*Dollars*
100	8	17.9	8.2	1,436	175
50–99	14	18.9	7.9	1,388	176
1–49	27	29.6	12.9	1,468	114
0	23	39.9	16.0	1,553	97

*Includes only those districts that contain no hamlet nor village and for which information on average daily attendance was available.

†Does not include capital outlays and debt service.

in each school in the higher land classes, the cost per pupil was relatively low. In districts wholly in land classes I and II the cost was $175 per pupil, as compared with $97 per pupil in districts altogether in land classes III, IV, and V.

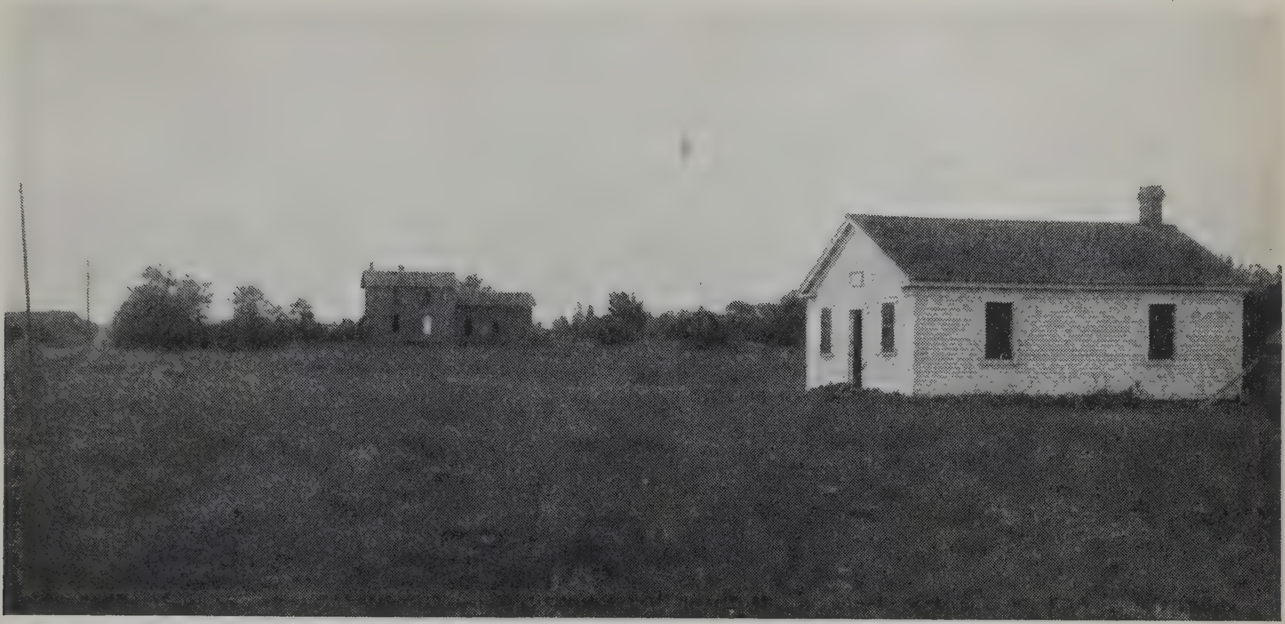

Figure 19. an area of land class i

The telephone line, farmstead, and school have all been abandoned. The school was removed shortly after this picture was taken. In sparsely settled areas such as this, the cost of providing public services is high

Although districts in land classes I and II were geographically about the same size as those in the higher land classes, they averaged only $212 per district from property taxes, as compared with $888 per district in the better areas (table 30). In order to finance their school costs, districts in land classes I and II had to rely heavily on state aid. In these districts, the state aid was nearly six times the school taxes. In land classes III, IV, and V, the state aid was only three-fourths of the school taxes. The school-tax rate per $1000 of taxable property did not vary greatly between land classes.

TABLE 30. School Taxes and State Aid for Schools in One-Teacher School Districts in Different Land Classes, Yates County, New York, 1936–37

Percentage of district in land classes I and II	School districts*	Average daily attendance per school	Average school tax per district	Average state aid per district	Average school tax per pupil	Average state aid per pupil	Per cent state aid was of district school tax
Per cent	*Number*	*Number*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Per cent*
100	8	8.2	212	1,218	26	149	575
50–99	14	7.9	349	1,004	44	127	288
1–49	27	12.9	650	833	50	65	128
0	23	16.0	888	694	56	43	78

*Includes only those districts that contain no hamlet nor village and for which information on average daily attendance was available.

In districts wholly within land classes I and II, the annual state aid for schools was 2.2 per cent of the full value of the taxable property (table 31). In 46 years the state aid in these districts would amount to enough to purchase all of the taxable property in the district; it would take 363 years in districts in land classes III, IV, and V.

If the areas of land classes I and II were used for forests and recreational purposes, the need for schools in these areas would be eliminated.

TABLE 31. FULL VALUE OF TAXABLE PROPERTY, SCHOOL TAXES, AND STATE AID IN ONE-TEACHER SCHOOL DISTRICTS IN DIFFERENT LAND CLASSES, YATES COUNTY, NEW YORK, 1936–37

Percentage of district in land classes I and II	School districts	Full value of taxable property per district	Percentage state aid was of income of district	Percentage state aid was of full value of district	Time required for state aid to equal full value of district
Per cent	*Number*	*Dollars*	*Per cent*	*Per cent*	*Years*
100	8	56,407	87	2.2	46
50–99	14	91,709	72	1.1	91
1–49	27	163,930	55	0.5	197
0	23	252,069	42	0.3	363

Farm fire insurance and fire protection

Insurance per farm

The records of the fire-insurance policies carried and of the losses sustained on 107 farms in Yates County were obtained for the 5-years period 1934–38.[8]

Farms in land classes IV and V carried about three times as much insurance on buildings as did those in land class II (table 32).[9] If all farms had carried as much insurance on buildings, household articles, stored produce, machinery, and livestock as the average for farms insur-

TABLE 32. AVERAGE ANNUAL AMOUNT OF FIRE INSURANCE PER FARM IN EACH LAND CLASS, 107 FARMS, YATES COUNTY, NEW YORK, 1934–38

Land class	Farms	Average insurance per farm*			
		Buildings	Household and produce	Machinery and livestock	Total
	Number	*Dollars*	*Dollars*	*Dollars*	*Dollars*
II	13	2,324	968	617	3,909
III	69	3,125	1,212	1,293	5,630
IV and V	25	6,096	1,880	1,485	9,461

*This is the average amount of insurance per farm insuring that type of property. Some of these farms did not carry insurance on all types of property or for each of the five years.

TABLE 33. AVERAGE ANNUAL AMOUNT OF FIRE INSURANCE ON 107 FARMS, YATES COUNTY, NEW YORK, 1934–38

Farm class	Farms	Average insurance per farm*			
		Buildings	Household and produce	Machinery and livestock	Total
	Number	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Very good and good	27	4,548	1,755	2,146	8,449
Fair	64	3,814	1,340	1,242	6,396
Poor	16	2,024	768	516	3,308

*See footnote to table 32.

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[8] Data are from the records of the New York Cooperative Underwriters, Albany, New York.

[9] This includes only the insurance carried by the one company whose records were studied. Some farms insuring with this company carried part of their insurance with other companies. The better farms in the higher land classes are more likely to do this than farms in land classes I and II, where the amount of insurance per farm is relatively small.

ing each of these types of property, the total insurance per farm would have been $3909 in land class II, $5630 in III, and $9461 in IV and V. Farms classified as very good and good had more than two and one-half times as much insurance as had those classified as poor (table 33).

Data on fire losses did not cover enough farms or a sufficiently long period to justify drawing conclusions. An earlier study in Tompkins County showed that losses per $1000 of insurance were about five times as great in land class II as in land class V.[10]

Fire protection

A study of the condition of insured farms in four southern New York counties showed that 17 per cent of the barns in land classes III, IV, V, and VI had fireproof roofs, while in land classes I and II only 8 per cent had this protection.[11] The chimneys of houses in the higher land classes were generally of better construction and in a more fire-resistant condition.

Proportion of farms with lightning rods

In Yates County, none of the farms in land class I, and only 18 per cent of those in land class II, had lightning rods on the house or barn (table 34). In land class V, more than one-half of the farms had lightning rods. Three-fourths of the farms classified as very good and good had rods, as compared with only 7 per cent of those classified as poor.

TABLE 34. PROPORTION OF FARMS WITH LIGHTNING RODS, YATES COUNTY, NEW YORK, 1938

Land class	Farm class				Average of land class
	Very good and good	Fair	Poor	Vacant	
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
I	..	*	*	*	0
II	*	43	5	7	18
I and II	*	42	5	6	17
III	77	42	8	12	37
IV	68	45	8	29	46
V	89	34	*	10	53
III, IV, and V	76	42	8	15	41
Average of farm class	76	42	7	11	36

*Fewer than 10 farms.

PROGRAMS FOR RURAL DEVELOPMENT

In order that farmers of Yates County may use their land to the best advantage, sound programs of rural development are necessary. It is desirable that these programs provide for the reforestation of areas not well adapted to farming. For the permanent agricultural areas, it is desirable that they provide for all-weather roads, extension of electric and telephone lines, good schools, and adequate health facilities. Farm fire insurance and credit should be available at a reasonable cost.

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[10] An economic study of land utilization in Tompkins County, New York. By A. B. Lewis. Cornell Univ. Agr. Exp. Sta. Bul. 590:34. 1934.

[11] Unpublished data from A. W. Peterson. Counties studied were Broome, Chemung, Cortland, and Tompkins.

Because of their importance to farmers, suggested road, electrification, and telephone programs are included in this study.

A PROGRAM OF ROAD IMPROVEMENT

It is desirable that all farms in permanent farming areas be served by *all-weather* roads. The income from farming in these areas is sufficient to justify such a system of roads. A road program has been prepared providing for extensions of existing all-weather roads, based on the number of farms and rural residences per mile and the amount of through traffic. Some extensions are suggested in land classes I and II to serve as connecting routes.

The unimproved roads have been divided into three groups: (1) those desirable to improve as all-weather roads; (2) those which probably should remain as permanent dirt or gravel roads; and (3) those that may eventually be needed only for forest or recreational travel.

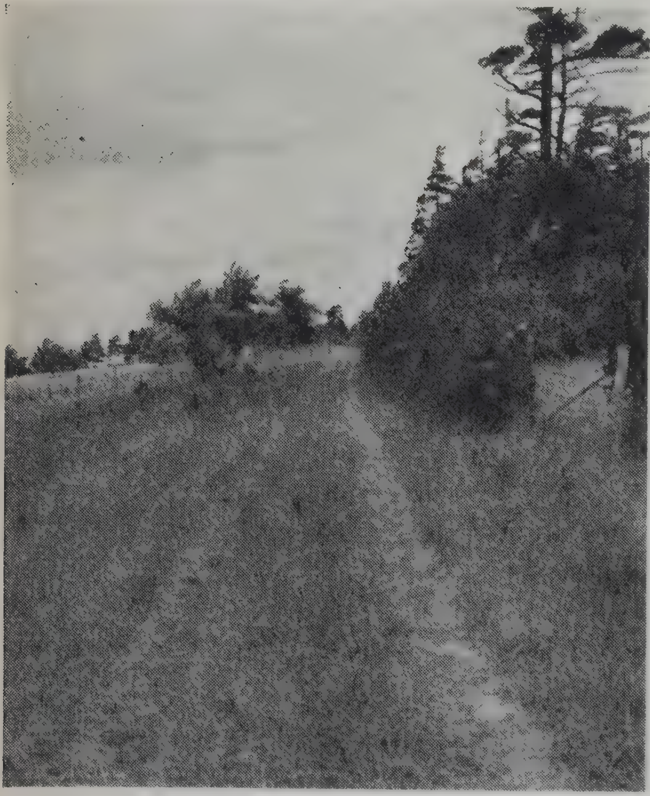

FIGURE 20. AN ABANDONED ROAD IN LAND CLASS II

If land classes I and II are retired from agriculture, many of the roads can be officially closed

Classes A, B, and C include roads suggested for improvement as all-weather roads. Class-A roads serve the most farms and rural residences per mile and probably should be improved first. Class-C roads serve fewer properties per mile than do roads in classes A and B.

Class D includes roads that probably should be left as permanent dirt or gravel roads. They serve so few farms and rural residences per mile that their improvement as all-weather roads does not seem justified, at least until roads in classes A, B, and C are improved. Class-D roads may well be drained and graded, and perhaps given some inexpensive improvement. Many of the little-traveled cross roads are in this class.

Classes E and F include roads which now or later may be closed or used only for forest or recreational travel. Most of these roads are in land classes I and II. Class-E roads now serve a few occupied farms or rural residences; most class-F roads serve none. A small mileage of these roads is in the higher land classes. In such instances, they serve no occupied houses and do not appear necessary.

Abandoned roads include those that have gone out of use since the United States Geological Survey maps were made in 1900.

The location of the different classes of roads is shown on the large land-classification map which accompanies this bulletin.

Mileage of each class of road

There are approximately 785 miles of roads in Yates County (table 35). Of the 365.2 miles of all-weather roads, 201.4 miles are hard-surfaced and 163.8 miles are sub-based or heavily graveled so that during the winter and spring months they support truck and automobile traffic without breaking through. If the suggested road program is followed, an additional 151.5 miles of existing dirt and gravel roads will be improved as all-weather roads. If this is done, 516.7 miles, or more than two-thirds of the total usable mileage, will be all-weather roads.

TABLE 35. MILES OF EACH CLASS OF ROAD IN EACH LAND CLASS, YATES COUNTY, NEW YORK, FEBRUARY 15, 1939

Road class	Land class								Yates County*
	I	II	III	IV	V	IR	IIR	IIIR	
	Miles	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*
All-weather roads:									
Hard-surfaced:									
State	0.7	6.2	43.8	21.8	4.4	0.7	7.5	7.1	100.8
County	....	15.3	37.4	26.0	10.6	....	5.7	2.3	100.6
Sub-based, gravel-surfaced	5.9	33.3	69.9	28.5	9.8	0.4	10.3	2.1	163.8
Total	6.6	54.8	151.1	76.3	24.8	1.1	23.5	11.5	365.2
Roads suggested for improvement as all-weather roads:									
Class A	....	....	12.0	19.1	3.0	....	0.4	0.2	35.2
Class B	....	....	23.5	9.0	2.1	....	0.9	....	36.1
Class C	0.1	3.1	62.5	8.4	....	2.0	3.6	....	80.2
Total	0.1	3.1	98.0	36.5	5.1	2.0	4.9	0.2	151.5
Permanent dirt or gravel roads:									
Class D	....	10.4	33.1	4.7	0.8	3.9	7.3	1.3	62.1
Roads which now or later may be closed or used only for forest or recreational travel:									
Class E	3.3	72.9	10.3	0.8	....	....	1.4	1.2	90.0
Class F	11.6	40.6	9.7	1.7	....	0.2	0.4	0.2	64.4
Total	14.9	113.5	20.0	2.5	....	0.2	1.8	1.4	154.4
Unused or abandoned roads	9.9	24.9	10.6	2.6	0.4	1.4	1.7	....	51.6
Total	31.5	206.7	312.8	122.6	31.1	8.6	39.2	14.4	784.8

*The total mileage for Yates County includes 15.5 miles of all-weather roads and 2.4 miles of dirt or gravel roads which were in areas classified as *residential*, outside incorporated villages. The mileage was obtained by measuring the roads on the United States Geological Survey maps. The total of 784.8 is 26.1 miles less than the 810.9 miles of road reported by the New York State Department of Public Works, Division of Highways.

There are 238.2 miles of roads in land classes I and II; of these, 34.8 miles have been abandoned. If land classes I and II are reforested, most of the roads in these areas will be needed only for forest or recreational travel.

Occupied properties per mile

On all-weather roads, there were 4.6 occupied properties per mile (table 36). On the roads suggested for improvement as all-weather roads, there were 3.3 properties per mile. Class-A roads had 5.2 properties per mile, of which a relatively high proportion were farms classified as good or very good.

TABLE 36. NUMBER OF OCCUPIED PROPERTIES PER MILE OF ROAD IN EACH ROAD CLASS, YATES COUNTY, NEW YORK, JULY 1, 1938

Road class	Farms					Occupied rural residences	Commercial establishments, churches, schools, and camps	Total occupied properties
	Very good	Good	Fair	Poor	Total			
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
All-weather roads:								
Hard-surfaced:								
State	*	0.6	2.0	0.6	3.2	1.1	0.4	4.7
County	0.1	0.7	2.0	0.7	3.5	1.5	0.6	5.6
Sub-based, gravel-surfaced	*	0.5	1.4	0.7	2.6	0.8	0.5	3.9
Average	*	0.6	1.7	0.7	3.0	1.1	0.5	4.6
Roads suggested for improvement as all-weather roads:								
Class A	0.1	0.7	2.2	0.3	3.3	1.7	0.2	5.2
Class B	0.1	0.5	1.6	0.3	2.5	0.1	0.1	2.7
Class C	0	0.2	1.5	0.5	2.2	0.4	0.2	2.8
Average	*	0.4	1.7	0.4	2.5	0.6	0.2	3.3
Permanent dirt or gravel roads:								
Class D	0	0	0.3	0.4	0.7	0.3	0.5	1.5
Roads which now or later may be closed or used only for forest or recreational travel:								
Class E	0	*	0.6	0.9	1.5	0.3	*	1.8
Class F	0	0	0	0.1	0.1	0.1	0.1	0.3
Average	0	*	0.3	0.6	0.9	0.2	0.1	1.2
Average of all used roads	*	0.4	1.3	0.6	2.3	0.7	0.3	3.3

*Fewer than 0.05 per mile.

Class-D roads served only 1.5 occupied properties per mile. Because they serve so few farms per mile, it is suggested that these roads remain as permanent dirt or gravel roads, at least until classes A, B, and C are improved.

Road classes E and F served 1.2 properties per mile. Most of the occupied farms on these roads were classified as fair or poor. Many of the properties which they once served are now abandoned.

Proportion of farms and rural residences on all-weather roads

In Yates County, 65 per cent of the farms and 70 per cent of the rural residences were on all-weather roads on July 1, 1938 (table 37). In land classes I and II, 41 per cent of the farms were on all-weather roads, as compared with 69 per cent in land classes III, IV, and V. In land class V, 91 per cent of the farms and 92 per cent of the rural residences were served by all-weather roads.

If the suggested road program is followed, and the A, B, and C roads are improved, every farm and rural residence in land classes IV and V will be on an all-weather road. In land class III, 98 per cent of the farms and 97 per cent of the rural residences will have all-weather roads; the few remaining properties are so isolated that the expense of building an all-weather road probably is not justified.

TABLE 37. PROPORTION OF OCCUPIED FARMS AND RURAL RESIDENCES ON ALL-WEATHER ROADS IN EACH LAND CLASS, YATES COUNTY, NEW YORK, JULY 1, 1938

Land class	Farms				Rural residences			
	Total	On all-weather roads		On all-weather roads if suggested extensions are built	Total	On all-weather roads		On all-weather roads if suggested extensions are built
	Number	*Number*	*Per cent*	*Per cent*	*Number*	*Number*	*Per cent*	*Per cent*
I	8	5	62	62	5	0	0	0
II	260	106	41	42	66	32	48	52
I and II	268	111	41	42	71	32	45	48
IR	0	0	0	0	3	0	0	67
IIR	66	50	76	92	62	34	55	82
IIIR	26	23	88	88	9	9	100	100
IR, IIR, and IIIR	92	73	79	91	74	43	58	84
III	764	486	64	98	206	162	79	97
IV	377	280	74	100	122	88	72	100
V	116	106	91	100	36	33	92	100
III, IV, and V	1,257	872	69	99	364	283	78	98
Total or average	1,617	1,056	65	89	509	358	70	89

Value of land and buildings on each class of road

In the strictly farming areas, the full value of land and buildings was higher on hard-surfaced roads than on dirt or gravel roads. For example, in land class III the average value of properties on state hard-surfaced roads was $67 per acre, and on sub-based roads with a gravel surface $60 per acre (table 38). Properties on A, B, and C roads had an average value of $57 per acre, while those on permanent dirt or gravel roads had a value of only $45 per acre. For the county as a whole, the average value per acre on roads suggested for improvement as all-weather roads was approximately the same as on existing all-weather roads. The average value per acre on road classes E and F was only $29, as compared with $63 on roads suggested for improvement as all-weather roads, and $65 on present all-weather roads.

A PROGRAM OF RURAL ELECTRIFICATION

Electric power is becoming more and more a necessity for the efficient operation of farm businesses. It is therefore desirable that all farms and rural residences in the permanent farming areas of Yates County be served by electric lines. The suggested electrification program, if carried out, will provide this service.

Availability of electric service

On February 15, 1939, one-half of the farms and two-thirds of the rural residences had electric service available (table 39). Not all properties to which electricity was available used it; only 40 per cent of the farms and 42 per cent of the rural residences actually were using electric power.[12]

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[12] When the properties were classified in June, 1938, the connections to electric and telephone lines were recorded. If lines went to a property, it was assumed that it was using the services. In some cases, this may not have been true. Home power plants were not recorded. The mileage and location of existing electric lines were corrected to February 15, 1939.

TABLE 38. FULL VALUE PER ACRE OF LAND AND BUILDINGS ON DIFFERENT ROAD CLASSES IN EACH LAND CLASS, YATES COUNTY, NEW YORK, 1938

Road class	Land class								Average
	I	II	III	IV	V	IR	IIR	IIIR	
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
All-weather roads:									
Hard-surfaced:									
State	*	25	67	83	112	*	52	133†	72
County	*	35	69	88	91	...	35	*	71
Sub-based, gravel-surfaced	24	32	60	76	83	*	80	*	57
Average	24	32	65	82	92	*	55	133	65
Roads suggested for improvement as all-weather roads:									
Class A	...	...	67	79	87†	...	...	...	75
Class B	*	*	57	70	*	...	*	...	62
Class C	...	40†	54	72†	...	*	68†	...	56
Average	*	41†	57	76	85	*	79	...	63
Permanent dirt or gravel roads:									
Class D	...	38	45	*	...	97†	166†	*	57
Roads which now or later may be closed or used only for forest or recreational travel:									
Class E	17†	32	*	...	...	...	*	*	32
Class F	26	22	*	*	...	...	*	...	23
Average	24	29	35†	*	...	...	*	*	29
Unused or abandoned roads	17†	19	40†	*	...	...	*	...	23
Average for each land class	23	30	61	81	91	91†	65	124	58

*Less than 500 acres.
†Based on less than 1000 acres.

TABLE 39. PERCENTAGE OF OCCUPIED FARMS AND RURAL RESIDENCES WITH ELECTRICITY, IN EACH LAND CLASS, YATES COUNTY, NEW YORK, FEBRUARY 15, 1939*

Land class	Percentage of farms†			Percentage of rural residences†		
	With electricity available	Using electricity	Using electricity where available	With electricity available	Using electricity	Using electricity where available
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
I	0	0	0	0	0	0
II	8	5	67	20	12	62
I and II	8	5	67	18	11	62
IR	0	0	0	100	100	100
IIR	27	17	61	60	52	86
IIIR	88	69	78	89	89	100
IR, IIR, and IIIR	45	32	71	65	58	90
III	50	39	78	67	36	55
IV	68	56	83	80	57	71
V	91	79	88	89	53	59
III, IV, and V	59	48	81	73	45	61
Average	50	40	80	64	42	66

*See footnote 12 on page 43.
†For total number of farms and rural residences in each land class, see table 37.

Electric service was available to a greater proportion of the properties in the higher land classes than to those in land classes I and II. In land class V, 91 per cent of the farms and 89 per cent of the rural residences had electricity available, while in land class II, only 8 per cent of the farms and 20 per cent of the rural residences had this service. Also, in the higher land classes a greater proportion of the properties used electricity where it was available.

Connections to electric lines, by different classes of properties

Nearly all of the farms classified as good or very good, but only one-half of the farms classified as poor, used electricity where it was available (table 40). Farms and commercial establishments in rural areas made greater use of electric service than did rural residences and other properties.

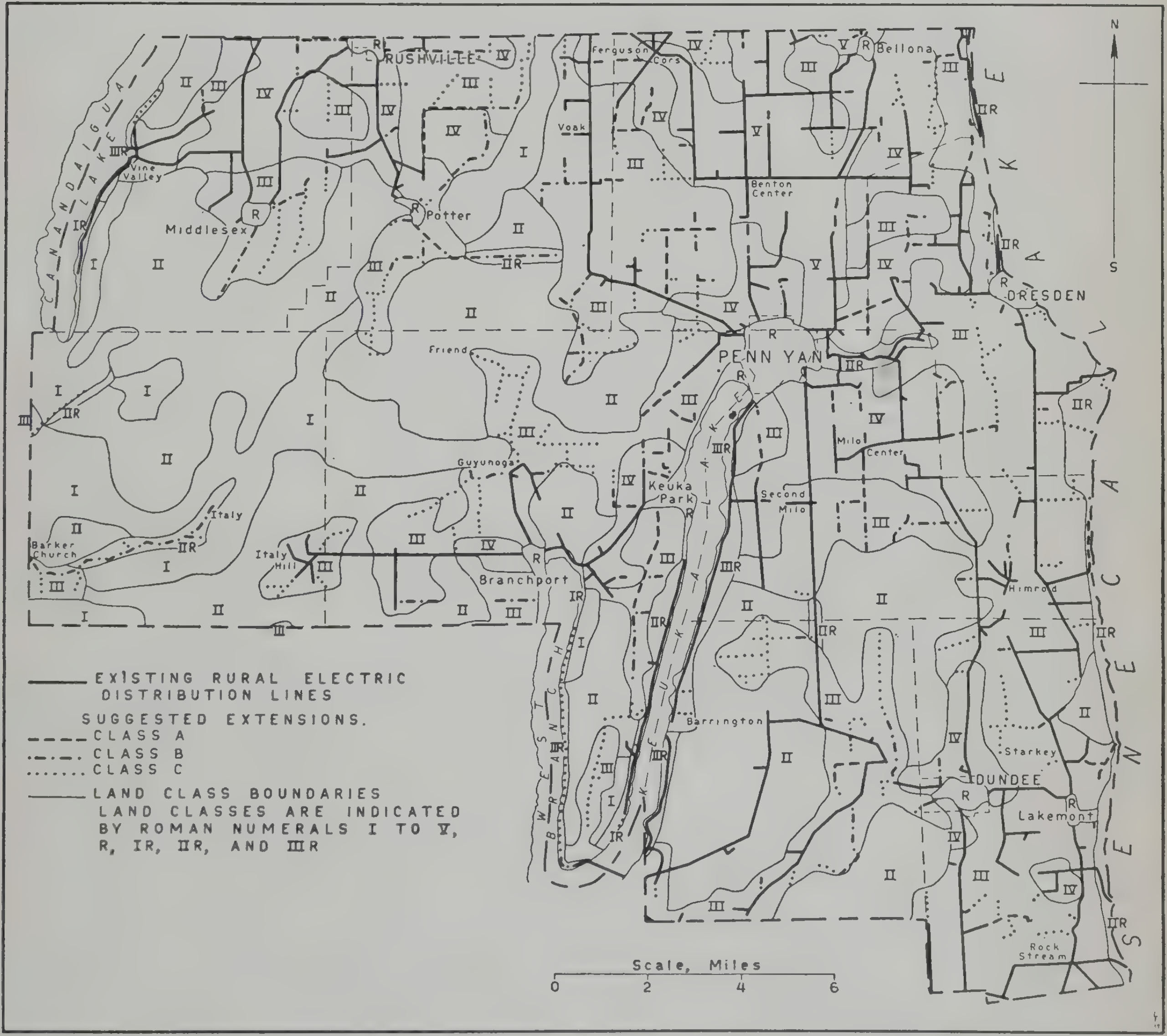

FIGURE 21. EXISTING RURAL ELECTRIC DISTRIBUTION LINES AND SUGGESTED EXTENSIONS, YATES COUNTY, FEBRUARY 15, 1939

About 56 per cent of the mileage needed to serve all permanent farms and rural residences had been constructed by February 15, 1939

Mileage of existing lines and suggested extensions

On February 15, 1939, there were 223.5 miles of electric distribution lines outside incorporated villages in Yates County (table 41). To serve all farms and rural residences in the permanent agricultural and rural

TABLE 40. PERCENTAGE OF EACH CLASS OF PROPERTY THAT USED ELECTRICITY, YATES COUNTY, NEW YORK, FEBRUARY 15, 1939

Class of property	Properties	Percentage that used electricity	Percentage with electricity available	Percentage that used electricity where available
	Number	*Per cent*	*Per cent*	*Per cent*
Farms:				
Very good	19	95	95	100
Good	267	64	67	94
Fair	931	42	51	81
Poor	400	17	31	55
Total or average	1,617	40	50	80
Rural residences:				
Good	340	54	73	73
Poor	169	20	47	41
Total or average	509	42	64	66
Camps	87	39	60	65
Commercial establishments	52	77	83	93
Churches and schools	91	27	47	58
Total or average	2,356*	41	54	76

*Does not include properties in hamlets of 20 or more occupied houses, incorporated villages, or rural residential areas where the properties were not counted.

residential areas, 175.8 miles of new lines are needed. In the electrification program, these lines have been divided into classes A, B, and C, based on the number of farms, rural residences, and other properties per mile of line and the probable consumption of each property (figure 21). The consumption on class-A extensions will probably be greater than on class-B extensions, and they probably should be built first. Class-C lines serve the smallest number of properties per mile. Their construction may well be delayed until the lines in classes A and B are completed. The suggested extensions in land class II are through lines to serve the higher land classes.

TABLE 41. MILEAGE OF EXISTING RURAL ELECTRIC DISTRIBUTION LINES AND SUGGESTED EXTENSIONS* IN EACH LAND CLASS, YATES COUNTY, NEW YORK, FEBRUARY 15, 1939

Class of line or extension	Land class†								Total mileage
	II	III	IV	V	IR	IIR	IIIR	Residential	
	Miles	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*
Existing lines	9.3	93.1	56.7	20.7	3.9	16.8	8.0	15.0	223.5
Suggested extensions:									
Class A	.....	20.0	15.1	1.6	.....	1.4	.....	0.2	38.3
Class B	0.3	34.0	11.3	0.6	.....	6.4	.....	0.2	52.8
Class C	1.9	62.8	8.6	0.5	1.5	7.2	1.8	0.4	84.7
Total	2.2	116.8	35.0	2.7	1.5	15.0	1.8	0.8	175.8
Total existing lines and suggested extensions	11.5	209.9	91.7	23.4	5.4	31.8	9.8	15.8	399.3

*The mileage was obtained by measuring the lines plotted on United States Geological Survey maps. It does not include any lines in incorporated villages.

†There were no existing lines or suggested extensions in land class I.

Number of consumers per mile

On existing electric distribution lines, there was an average of 6.3 possible consumers per mile, of which 4.7 were using service (table 42). In addition, the existing lines served rural residential areas and hamlets. If the same proportion of each class of property connects to new lines if they are built, the probable number of consumers per mile will be: class A, 4.6; class B, 3.5; and class C, 2.4. If all of the suggested extensions are built, and if the number of rural properties remains about the same, there will be 5.3 possible consumers per mile. Of these, 4.0 per mile probably will use the service.

TABLE 42. NUMBER OF CONSUMERS PER MILE ON EXISTING RURAL ELECTRIC DISTRIBUTION LINES AND SUGGESTED EXTENSIONS, YATES COUNTY, NEW YORK, FEBRUARY 15, 1939*

	Farms				All farms	Rural residences		Other properties†	All properties†
	Very good	Good	Fair	Poor		Good	Poor		
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Existing lines:									
Possible consumers......	0.1	0.9	2.3	0.6	3.9	1.3	0.4	0.7	6.3
Actual consumers.......	0.1	0.8	1.9	0.3	3.1	0.9	0.2	0.5	4.7
Class-A extensions:									
Possible consumers......	‡	1.0	3.1	0.6	4.7	0.7	0.3	0.2	5.9
Probable consumers.....	‡	0.9	2.5	0.4	3.8	0.6	0.1	0.1	4.6
Class-B extensions:									
Possible consumers......	0	0.5	2.3	0.8	3.6	0.6	0.3	0.3	4.8
Probable consumers.....	0	0.5	1.8	0.4	2.7	0.5	0.1	0.2	3.5
Class-C extensions:									
Possible consumers......	0	0.3	1.4	0.8	2.5	0.2	0.2	0.4	3.3
Probable consumers.....	0	0.2	1.2	0.4	1.8	0.2	0.1	0.3	2.4
All lines and extensions:									
Possible consumers......	‡	0.7	2.2	0.7	3.6	0.9	0.3	0.5	5.3
Probable consumers.....	‡	0.7	1.8	0.4	2.9	0.6	0.1	0.4	4.0

*See footnote 12 on page 43.

†Does not include properties in incorporated villages, hamlets with more than 20 houses, or some of the camps and cottages along the lakes where the buildings were not counted.

‡Less than 0.05 per mile.

RURAL TELEPHONE LINES

Availability of telephone service

Rural telephone service was established long before the development of rural electrification. Telephone lines are less costly to build and maintain than electric lines. For these reasons, there were about twice as many miles of telephone lines as of electric lines in the county on July 1, 1938. Eighty per cent of the farms and 83 per cent of the rural residences were on telephone lines (table 43). The proportion of farms and residences using telephone service where available was much smaller than for electric service. Of those on telephone lines, only about three-fifths of the farms and one-third of the rural residences had telephones. A greater proportion of the properties in the higher land classes had telephones than of those in land classes I and II.

TABLE 43. PERCENTAGE OF OCCUPIED FARMS AND RURAL RESIDENCES ON TELEPHONE LINES IN EACH LAND CLASS, YATES COUNTY, NEW YORK, JULY 1, 1938*

Land class	Percentage of farms†			Percentage of rural residences†		
	With telephone service available	Using telephones	Using telephones where available	With telephone service available	Using telephones	Using telephones where available
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
I	75	38	50	..	..	..
II	50	25	50	52	12	24
I and II	51	25	50	48	11	24
IR	..	..	..	67	67	100
IIR	80	35	43	66	34	51
IIIR	96	46	48	89	78	88
IR, IIR, and IIIR	85	38	45	69	41	59
III	85	51	59	92	24	26
IV	88	56	64	92	32	35
V	91	58	64	97	31	31
III, IV, and V	86	53	61	92	27	29
Average	80	48	59	83	27	33

*See footnote 12 on page 43.
†For the total number of farms and rural residences in each land class, see table 37.

Connections to telephone lines, by different classes of properties

All of the very good farms and four-fifths of the good farms, but only one-third of the poor farms, had telephones where the service was available (table 44). Farms and commercial establishments in rural areas made greater use of telephone service than did rural residences and other classes of properties. For the county as a whole, one-half of the properties used telephone service where it was available.

TABLE 44. PERCENTAGE OF EACH CLASS OF PROPERTY THAT USED TELEPHONES, YATES COUNTY, NEW YORK, JULY 1, 1938

Class of property	Properties	Percentage that used telephones	Percentage with telephone service available	Percentage that used telephones where available
	Number	*Per cent*	*Per cent*	*Per cent*
Farms:				
Very good	19	84	84	100
Good	267	72	91	79
Fair	931	50	83	60
Poor	400	24	68	35
Total or average	1,617	48	80	59
Rural residences:				
Good	340	37	90	42
Poor	169	6	69	9
Total or average	509	27	83	33
Camps	87	11	34	33
Commercial establishments	52	62	96	64
Churches and schools	91	0	85	0
Total or average	2,356	40	80	50

Mileage of existing lines and suggested extensions

On July 1, 1938, there were 404.7 miles of telephone lines in Yates County (table 45). In order to provide all properties in permanent agricultural or rural residential areas with telephone service, an additional 66.4 miles of line would be needed. Perhaps less than 66.4 miles of new lines would be needed to serve those properties desiring telephone service.

The mileage of suggested extensions has been divided into three classes, based on the number and classification of properties to be served per mile (figure 22). Class-A extensions would serve the most properties per mile and probably should be built first. Class-B extensions would serve more properties than those in class C and probably should be built next.

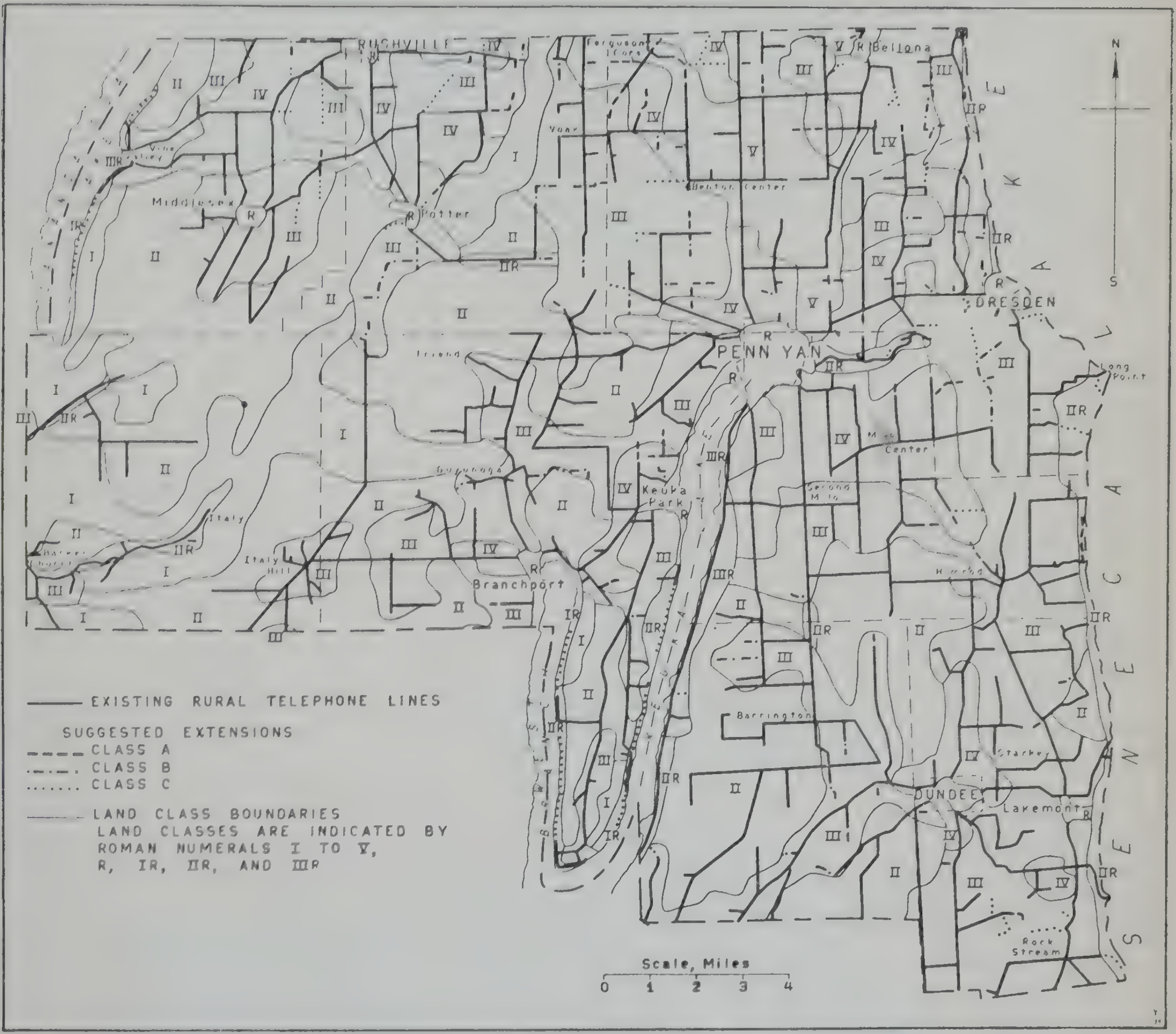

FIGURE 22. EXISTING RURAL TELEPHONE LINES AND SUGGESTED EXTENSIONS, YATES COUNTY, JULY 1, 1938

Telephone service was available to 86 per cent of the farms in the permanent agricultural areas on July 1, 1938

Comparative use of electric and telephone service

Of the 1617 occupied farms in land classes I to V, 762, or 47 per cent, were on both electric and telephone lines (table 46). Of these farms, four-fifths used electricity, but only three-fifths had telephones. About one-half used both services.

TABLE 45. MILEAGE OF EXISTING RURAL TELEPHONE LINES AND SUGGESTED EXTENSIONS IN EACH LAND CLASS, YATES COUNTY, NEW YORK, JULY 1, 1938

Existing line or extension	Land class									Total mileage
	I	II	III	IV	V	IR	IIR	IIIR	Residential	
	Miles	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*	*Miles*
Existing lines	4.9	59.2	188.3	81.7	23.5	1.6	21.7	8.5	15.3	404.7
Suggested extensions:										
Class A	....	....	9.2	6.3	2.3	....	1.1	....	0.5	19.4
Class B	....	0.3	14.8	3.6	....	....	0.3	....	....	19.0
Class C	....	....	10.6	4.5	0.1	3.8	7.3	1.6	0.1	28.0
Total	....	0.3	34.6	14.4	2.4	3.8	8.7	1.6	0.6	66.4
Total existing lines and suggested extensions	4.9	59.5	222.9	96.1	25.9	5.4	30.4	10.1	15.9	471.1

TABLE 46. NUMBER OF OCCUPIED FARMS WITH BOTH ELECTRICITY AND TELEPHONES AVAILABLE, AND PROPORTION USING THESE SERVICES, YATES COUNTY, NEW YORK, JULY 1, 1938

Land class*	Farms	Percentage of farms using—						
		Both electric and telephone service	Electric service only	Telephone service only	Neither service	Total	Electric service†	Telephone service‡
	Number	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
II	20	45.0	20.0	5.0	30.0	100.0	65.0	50.0
III	364	49.7	28.3	7.4	14.6	100.0	78.0	57.1
IV	245	61.2	22.9	4.1	11.8	100.0	84.1	65.3
V	95	64.2	25.3	3.1	7.4	100.0	89.5	67.3
IIR	15	40.0	13.3	26.7	20.0	100.0	53.3	66.7
IIIR	23	39.1	39.1	8.7	13.1	100.0	78.2	47.8
Total or average	762	54.6	26.0	6.2	13.2	100.0	80.6	60.8

*There were no occupied farms in land classes I and IR with both electric and telephone service availabl

†Includes those farms using both services and those using electric service only.

‡Includes those farms using both services and those using telephone service only.

A greater proportion of the farms in the higher land classes used thes services than in the lower land classes. None of the farms in land classe I and IR had both electricity and telephones available. In land class II 65.0 per cent of the farms used electricity and 50.0 per cent used telephone where both were available; in land class V, 89.5 per cent used electricit and 67.3 per cent used telephones. Forty-five per cent of the farms i land class II, 49.7 per cent in land class III, and 64.2 per cent in land clas V used both services where they were available.

REFORESTATION

Although land classes I and II are better suited to forests and recre tional uses than to farming, the appearance of this land is deceivin Inexperienced persons with high hopes for the future, but small amoun of capital, are attracted to these areas by the cheapness of the land. T courage and resources of many of these buyers are soon depleted and th are forced either to accept a relatively low standard of living, with fr

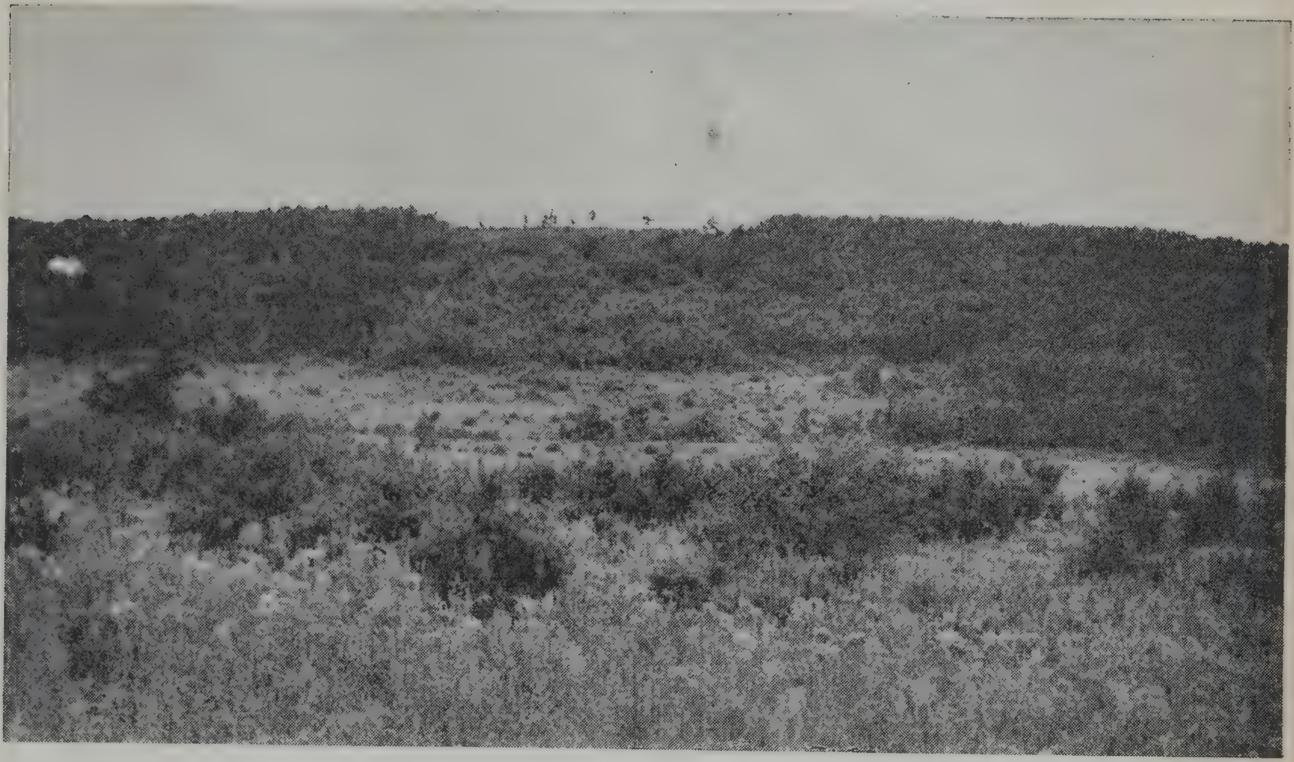

FIGURE 23. NATURAL REFORESTATION IN LAND CLASS I

By May 15, 1939, the State and Federal Governments had acquired about 3500 acres in Yates County. On this land, trees either have been or will be planted instead of waiting for natural reforestation to occur

quent public assistance, or to abandon the land, leaving it available for other inexperienced buyers. Unless land classes I and II are removed permanently from agriculture, this vicious circle is likely to continue. Such areas could well be used for forests and recreational purposes. Reforestation of land requires a long-time investment and probably will have to be done by governmental agencies.

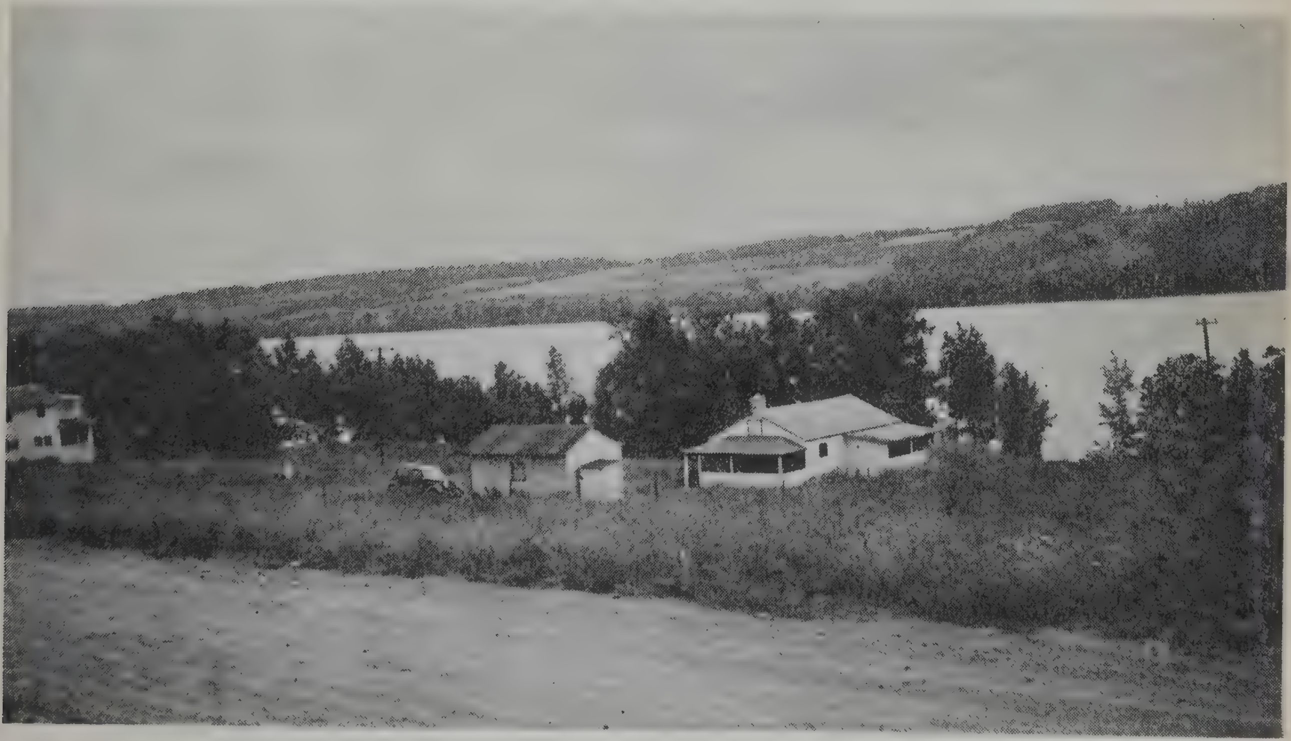

FIGURE 24. COTTAGES ALONG KEUKA LAKE

Recreational and residential opportunities are provided by the three lakes in Yates County

Land classes I and II comprise 36.6 per cent of the area of Yates County, but form only a small part of the taxable property. To retire this land from farming would have only a slight effect on the county tax base. Under the laws providing for state purchase and reforestation of land, the State pays the town and school taxes on the land it buys for reforestation, at an assessment not to exceed the purchase price of the land. In addition, state aid for schools and highways makes up for some of the loss of tax revenue in areas where the State has purchased land for reforestation. By September 30, 1939, the State had acquired 1771 acres in land classes I and II for reforestation purposes. By May 15, 1939, the Federal Government had purchased or had under option 1732 acres.

By gradually retiring land classes I and II from farming, the costs of governmental and private services to farmers in the higher land classes probably can be reduced. Reforestation of this land will decrease the miles of roads and number of schools needed; it will tend to lower farm-credit and fire-insurance losses and public-relief costs; and the time, courage, and money of prospective farmers will not be lost in land classes I and II. Reforesting this land will reduce soil erosion and help prevent floods by checking the runoff of water. A timber supply for future generations will be provided, and public camping, hunting, and picnicking grounds will be made available. It will make Yates County a more beautiful and desirable place in which to live.

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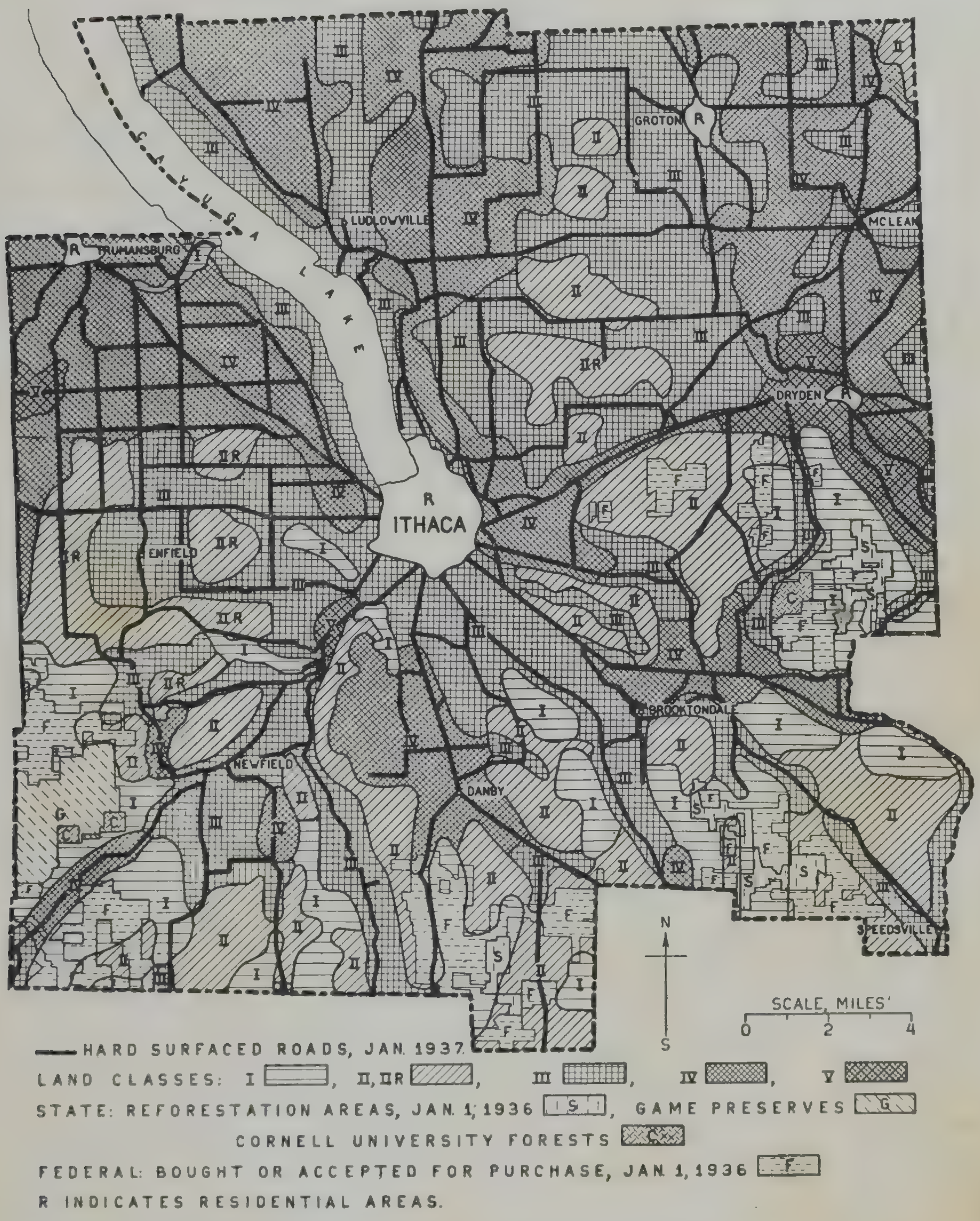
Bulletin 728 March 1940

An Economic Study of Farming in Tompkins County, New York, 1937

Philip A. Henderson


CAYUGA LAKE
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DRYDEN
ITHACA
ENFIELD
NEWFIELD
DANBY
BROOKTONDALE
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HARD SURFACED ROADS, JAN. 1937
LAND CLASSES: I, II, IIR, III, IV, V
STATE: REFORESTATION AREAS, JAN. 1, 1936 S, GAME PRESERVES G
CORNELL UNIVERSITY FORESTS C
FEDERAL: BOUGHT OR ACCEPTED FOR PURCHASE, JAN. 1, 1936 F
R INDICATES RESIDENTIAL AREAS.

LAND-CLASSIFICATION MAP OF TOMPKINS COUNTY
The higher the number, the higher is the proportion of well-drained soil, and the more intensive is the use made of the land

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Cornell University Agricultural Experiment Station
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AN ECONOMIC STUDY OF FARMING IN TOMPKINS COUNTY, NEW YORK, 1937[1]

PHILIP A. HENDERSON

Farm-management studies of farms in Tompkins County, New York, were made for the crop years 1907, 1917, 1927, and 1937.[2] The present bulletin reports the findings of the study made for the crop year 1937.

METHOD OF STUDY

The records were obtained by the survey method from all active farmers who were willing to cooperate in furnishing the information. Usable reports giving complete details of receipts and expenses were obtained from 66 farmers in Danby Township, 150 in Dryden, 141 in Groton, 113 in Lansing, and 74 in Ulysses—a total of 544 farms in Tompkins County—for the year ended on March 31, 1938.

Some of these farmers derived sufficient income off the farm so that it was necessary to study their farms separately from farms not having such income.

DEFINITION OF TERMS

Farm capital is the value of all farm property, including land, buildings, livestock, equipment, and feed and supplies. The average of the value of these items at the beginning and at the end of the year was considered to be the average farm capital for the year. Property of both the landlord and the tenant was included.

Farm income is the difference between total receipts and total expenses. It is what the operator receives for his year's work and for the use of the farm capital.

Farm labor income is the amount of income left as pay for the operator's labor and for the supervision given by the landlord after farm expenses and interest at 5 per cent on the capital are deducted from the farm receipts. In addition to the labor income, the operator and/or the landlord had the use of the house, and farm products produced on the farm and consumed by the family. To compute the farm labor income, all farms were considered as owner-operated farms regardless of tenure. A minus sign preceding a labor-income figure signifies that the farm income was not sufficient to equal the interest by the amount of the minus income.

Farm labor earnings is the farm labor income plus the value of the family privileges from the farm. It is the measure of income most nearly comparable to the wage of the city worker.

Return on farm capital is the farm income less the value of the operator's time.

Per cent return on farm capital is the return on farm capital expressed as a percentage of the average farm capital.

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[1] Also presented to the Faculty of the Graduate School at Cornell University, September 1939, as a thesis in partial fulfillment of the requirements for the degree of doctor of philosophy.

This bulletin is one of a series prepared under the direction of E. G. Misner.

Lloyd E. Slater and Norman Thompson assisted in the field work.

[2] Results for 1907 were published in *An Agricultural Survey*, by G. F. Warren and K. C. Livermore (Cornell Univ. Agr. Exp. Sta., Bul. 295, 1911).

Labor returns is the total income to all labor on the farm. It is the difference between farm receipts, and the sum of the interest on capital and all expenses except labor; that is, the total labor expense including the value of unpaid labor and of board furnished to hired help, plus the farm labor income, equals the labor returns.

Labor returns per man is the total labor returns divided by the man equivalent.

Man equivalent is the average number of persons working for the year, reduced to an adult-male basis. It is obtained by adding the total months of labor on the farm, including twelve months for the operator, and dividing by 12. Work done by women and children is expressed as the time required for a man to do the same work.

Expense for unpaid labor is the charge made to the farm business for the work done by members of the family or by others who do not receive a regular wage. The charge is made at the rate that it would cost the operator to hire the same work done by an adult man.

An animal unit is the number of animals of each kind in terms of a mature horse or cow. Thus each cow counts as one unit, each heifer or calf as one-half unit, and each 100 mature fowls as one unit.

A productive-man-work unit is the average amount of work one man can accomplish in a ten-hour day in the production of crops, livestock, or livestock products, or in labor off the farm. Work spent in care of work stock, repairing machinery, or other work connected with the upkeep of the farm, is not included in calculating the number of productive-man-work units, as it is considered non-productive work.

Net livestock increase is the amount by which the sum of the livestock sales and the value of livestock on hand at the end of the year, exceeds the sum of the livestock purchased and the value of livestock on hand at the beginning of the year. If the purchases and the beginning inventory exceed the sales and the end inventory, the difference is a *net livestock decrease*.

Net increase in other capital is the amount by which the value of capital other than livestock on hand at the end of the year exceeds the value of capital other than livestock on hand at the beginning of the year. If the latter is greater than the former, there is a *net decrease in other capital*.

Crop index, as used in this bulletin, is the yields of all crops on a particular farm expressed as a percentage of the average yields for the same crops in the entire area. In this study, the yields on each farm were weighted by the average productive-man-work units required to produce the amount of each crop grown.

Special farms are (1) those farms whose owners received as much as $250 or more from sources other than their own farm, or (2) those farms where the nature of the receipts differed markedly from those on the majority of the farms visited. There were 91 "special" farms. The remaining 453 farms were considered *regular farms*.

Land class indicates the intensiveness of present and probable future use of land. The higher the land class, the better is the land and the more intensive is the use made of it.

Owners are those farmers who own all of the land which they operate.

Part owners are those farmers who rent some land in addition to what they own.

6034

Share tenants are those farmers who rent on a share basis.

Cash tenants are those farmers who rent on a cash basis.

Mixed tenants are those farmers who rent on both a share and a cash basis.

LOCATION AND DESCRIPTION OF THE AREA

Tompkins County lies at the southern tip of Cayuga Lake, on the southeastern edge of the area known as the Finger Lakes Region of New York. This is slightly to the west and south of central New York, entirely within the area known as the Allegheny Plateau.

Ithaca, the only city within the county, has a population of about 21,738, and represents 50 per cent of the population in Tompkins County.[3] It furnishes a market for a limited amount of farm products.

The nearest large cities are Syracuse and Binghamton, both of which are 20 miles or more from any part of Tompkins County. New York City is 250 miles from the center of Tompkins County. Practically all of the milk, the chief product in this area, is sent to New York City in fluid form. Most of the beans produced in the county are sold to dealers in Trumansburg. Most of the cabbage and potatoes are sold to truckers.

Opportunities for part-time work are furnished by the Corona typewriter factory located in Groton, the salt mines near Ludlowville, the cement plant near Myers, and the Morse chain factory in Ithaca. Many of the farmers from whom records were obtained took advantage of these opportunities during the year for which this study was made.

CLIMATE

The mean annual precipitation at Ithaca and at Cortland is 34 inches and 38 inches, respectively; of this amount, approximately 17 inches normally falls during the growing season at Ithaca, as compared with 19 inches at Cortland. The average mean monthly temperature during the growing season is about 65° F. at Ithaca, and approximately 63° at Cortland. In the year for which this study was made, precipitation during the growing season was 125 per cent of normal at Ithaca and 92 per cent of normal at Cortland. Temperatures were slightly above normal at both stations. The growing season in 1937 was unusually long. The last killing frost occurred on April 17 at both stations; the first killing frost in the fall was October 14. This was a frost-free period nearly three weeks longer than is normal for the region.

NATURAL FEATURES

Tompkins County is approximately square. The total area is about 476 square miles, or approximately 304,000 acres. The elevation of the county varies from 381 feet to more than 2000 feet above sea level. The topography of the southern half of the county is much rougher than that of the northern part, which might be described as rolling. Because of the more level topography, the lower elevation, and the more complete glaciation of the soil, the northern part of the county is much better suited to farming than is the southern part.

A large proportion of the land in Tompkins County was originally forested with sugar maple, beech, yellow birch, hemlock, and white pine. The soils in the county have been characterized as generally low in organic matter. Many of them have poor natural drainage. Liming is usually necessary to ensure a good stand and crop of legumes. The texture and the derivation of the soils differ widely. For these reasons, the problems of soil management are many.[4]

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[3] 1935 estimate by the State Department of Health, New York State Legislative Manual, 1938, p. 857.

PRICE CONDITIONS

The success of a farmer depends to a large extent on the movement of the general price level. In periods of low prices, as in 1937 and 1938, prices of agricultural products are relatively low in relation to the prices of most other products.

When prices for the State in 1910–1914 are taken as 100, the price of milk in 1937 was 108 per cent of the average as compared with 145 for the price of cows, 135 for cabbage, 120 for potatoes, 100 for eggs, 117 for wheat, 116 for buckwheat, and 68 for hay.

Wages and prices of commodities which farmers had to buy were relatively high in 1937. Based on wages and prices in 1910–1914 taken as 100, wages in 1937 were 129, the wholesale price of a dairy ration was 125, the wholesale price of a poultry ration was 126, machinery prices were 154, and taxes were 249.

TYPE OF FARMING

Most of the farming in Tompkins County is centered about dairying. The intensity of the dairy enterprise varies considerably with the type of outlet for the milk. Consequently, a classification of the farms as to their market outlet for milk gives a fairly good indication of the type of farming.

Of the 453 regular farms, 139 sold milk at Grade A plants, 126 sold milk at Grade B plants, and 154 sold cream, butter, veals, or some combination of these, or else sold most of the milk not needed for family use to their neighbors. The remaining 34 farms in the regular group either produced no milk, or produced very little and had no one particular outlet for it.

All of the farms in each of these groups of regular farms which had as many as 400 hens or more were analyzed in a distinct group. This finally resulted in the following classification as to type of farming: 131 Grade A farms; 122 Grade B farms; 129 other dairy farms; 40 poultry farms; and 31 miscellaneous-type farms. In this study, these groups of farms are called "Grade A", "Grade B", "other dairy", "poultry", and "miscellaneous-type" farms.

BY TENURE

Approximately 90 per cent of the farms in each type of farming group were operated by owners and part owners, except in the case of poultry farms, of which 98 per cent were operated by owners or part owners. There were proportionately more part owners on the Grade B farms than on any other type of farm.

BY TOWNSHIP

Dairying is more intensive in Dryden and Groton Townships than in the other townships studied. The production of market milk has never been an important part of the system of farming in either Lansing or Ulysses Township. Grade A markets were established in the regions of most intensive milk production.

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[4] Soil survey of Tompkins County, New York, p. 1578–1581, by Frank B. Howe and others.

The distribution of the farms in each type of farming group by land classes is shown in table 1. In those townships where dairying was most important, the farms that had the best milk market tended to be located in the higher land classes.

TABLE 1. NUMBER OF FARMS IN EACH LAND CLASS, BY TYPES OF FARMING

Land class	Grade A farms	Grade B farms	Other dairy farms	Poultry farms	Miscellaneous-type farms	All regular farms	Special farms
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
I	..	..	2	..	..	2	..
II	5	10	7	2	4	28	6
III	25	47	44	8	8	132	35
IV	78	59	73	29	18	257	42
V	23	6	3	1	1	34	8
Total	131	122	129	40	31	453	91

Of the 544 farms studied, 7 per cent were in land classes I and II, 30 per cent in land class III, 55 per cent in land class IV, and 8 per cent in land class V. The distribution of the regular farms was approximately the same as for the special farms studied.

TRUCKS AND TRACTORS

The importance of trucks and tractors in the farming operations in Tompkins County has increased considerably in recent years.

TRUCKS

Approximately one-third of the 18 trucks purchased on the regular farms during the year for which this study was made, were purchased on farms that did not have trucks at the beginning of the year. There were 2 trucks sold and not replaced.

Only one-fourth, or 25 per cent, of all the regular farms had trucks. These were found on 37 per cent of the Grade A farms, 25 per cent of the Grade B farms, 16 per cent of the other dairy farms, 22 per cent of the poultry farms, and 13 per cent of the miscellaneous-type farms. Of the special farms, 35 per cent had trucks.

Details of the costs were not obtained on all trucks. The use of buildings, and farm labor, were not included in the costs as shown in table 2. Because of the relatively small number of trucks, no attempt was made to analyze costs of trucks according to capacity ratings.

TRACTORS

Of the 5 10–20 tractors purchased on these farms during the year for which this study was made, 4 were purchased on farms that did not have tractors at the beginning of the year. Of the 23 other tractors purchased, 13 were purchased on farms that had no tractors at the beginning of the year. On the Grade A farms, 7 out of 10 tractors purchased were purchased on farms that had no tractors at the beginning of the year. There were no tractors sold which were not replaced.

Approximately one-half, or 46 per cent, of the farms had tractors of some kind. The poultry farms had relatively more tractors than did any other type of farm. Tractors were found on 65 per cent of these farms. Only 36 per cent of the other dairy farms had tractors.

TABLE 2. COSTS OF OPERATING 84 TRUCKS, BY TYPES OF FARMING, 1937*

	Grade A farms		Grade B farms		Other dairy farms	
Number of trucks	43		27		14	
Number of miles driven, 1937	4,507		4,134		4,393	
	Costs		Costs		Costs	
	Per truck	Per mile	Per truck	Per mile	Per truck	Per mile
	Dollars	*Cents*	*Dollars*	*Cents*	*Dollars*	*Cents*
Average value	205	...	173	...	125	...
Costs:						
Depreciation	51	1.1	30	0.7	20	0.5
Interest	10	0.2	9	0.2	6	0.1
Insurance	6	0.1	9	0.2	5	0.1
License	23	0.5	21	0.5	21	0.5
Tires	10	0.2	7	0.2	8	0.2
Repairs	13	0.3	10	0.2	10	0.2
Fuel	58	1.3	45	1.1	63	1.4
Oil	6	0.1	5	0.1	7	0.2
Other costs	2	0.1	3	0.1	3	0.1
Total costs	179	3.9	139	3.3	143	3.3

*Data were obtained for only 6 trucks on poultry farms and 2 trucks on miscellaneous-type farms.

About one-third of the tractors for which costs were obtained were 10–20 tractors. The rest were chiefly smaller tractors, such as the Fordson, Farmall F 12, and other miscellaneous types. Costs for all these tractors are shown in tables 3 and 4.

TABLE 3. COSTS OF OPERATING 70 10–20 TRACTORS, BY TYPES OF FARMING, 1937*

	Grade A farms		Grade B farms		Other dairy farms		Poultry farms	
Number of tractors	22		21		16		11	
	Costs		Costs		Costs		Costs	
	Per tractor	Proportion of total	Per tractor	Proportion of total	Per tractor	Proportion of total	Per tractor	Proportion of total
	Dollars	*Per cent*	*Dollars*	*Per cent*	*Dollars*	*Per cent*	*Dollars*	*Per cent*
Average value	449	...	442	...	424	...	440	...
Costs:								
Depreciation	34	18	51	29	46	24	39	19
Interest	22	12	22	13	21	11	22	11
Fuel	81	43	73	41	81	43	107	52
Oil	17	9	13	7	14	8	19	9
Repairs	32	17	18	10	23	13	19	9
Other costs	1	1	1	0	2	1	0	0
Total costs	187	100	178	100	187	100	206	100

*Only 4 10–20 tractors were found on miscellaneous-type farms.

TABLE 4. COSTS OF OPERATING 134 OTHER TRACTORS, BY TYPES OF FARMING, 1937

	Grade A farms		Grade B farms		Other dairy farms		Poultry farms		Miscellaneous-type farms	
Number of tractors	46		39		28		12		9	
	Costs		Costs		Costs		Costs		Costs	
	Per tractor	Proportion of total	Per tractor	Proportion of total	Per tractor	Proportion of total	Per tractor	Proportion of total	Per tractor	Proportion of total
	Dollars	*Per cent*	*Dollars*	*Per cent*	*Dollars*	*Per cent*	*Dollars*	*Per cent*	*Dollars*	*Per cent*
Average value	365	...	309	...	330	...	275	...	303	...
Costs:										
Depreciation	54	36	46	31	53	34	45	28	22	15
Interest	18	12	15	11	17	11	14	8	15	11
Fuel	59	40	66	45	67	43	76	46	75	53
Oil	8	6	10	7	12	8	12	7	13	9
Repairs	9	6	6	4	5	3	17	11	17	12
Other costs	0	0	3	2	1	1	0	0	..	..
Total costs	148	100	146	100	155	100	164	100	142	100

Grade A, Grade B, and other dairy farms with tractors were separated from those without tractors, and some indication of the differences is shown in table 5. The farms with tractors kept approximately the same number of horses as did the farms without tractors. They had from 163 per cent as many acres of crops on the Grade B farms, to 223 per cent as many on the other dairy farms. In addition, they kept from 129 to 159 per cent as many animal units other than work animals. Their businesses were 157 per cent of those without tractors, in size as measured by productive-man-work units, on the Grade A farms, 139 per cent on the Grade B farms, and 191 per cent on the other dairy farms. The farms with tractors were operated by younger men than were the farms without tractors, and had higher labor efficiency. The farms without tractors had a slightly

TABLE 5. COMPARISON OF FARMS WITH AND FARMS WITHOUT TRACTORS, 382 FARMS, 1937

	Grade A farms		Grade B farms		Other dairy farms	
	With tractors	Without tractors	With tractors	Without tractors	With tractors	Without tractors
Number of farms	66	65	64	58	46	83
Acres of crops per farm	90	54	96	59	96	43
Animal units, except work animals	26.0	17.0	21.6	16.7	11.6	7.3
Total productive-man-work units	539	343	483	348	356	186
Number of horses per farm	2.7	2.6	2.9	2.8	2.2	2.3
Man equivalent	2.1	1.7	2.0	1.7	1.8	1.3
Per cent of productive-man-work units on cows	52	54	47	51	24	32
Productive-man-work units per man	254	206	244	200	198	146
Capital per productive-man-work unit	$23	$25	$22	$21	$27	$27
Age of operator (years)	47	55	49	50	52	57

larger proportion of their total work units on cows than did the farms that had tractors, on each of the three types of dairy farms. The amount of capital employed per man-work unit was practically the same, regardless of whether or not the farm had a tractor.

USE OF LAND

On the Grade A farms the total acres operated were 149; on the Grade B farms, 168; on the other dairy farms, 112; on the poultry farms, 124; on the miscellaneous-type farms, 128; and on the special farms, 143 (table 6).

TABLE 6. USE OF LAND BY TYPES OF FARMING, ACRES PER FARM, 544 FARMS, 1937

	Grade A farms	Grade B farms	Other dairy farms	Poultry farms	Miscellaneous-type farms	Special farms
Number of farms	131	122	129	40	31	91
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Crops	76	83	66	79	67	71
Double-cropped	5	5	6	7	5	6
Total cropland	71	78	60	72	62	65
Woods not pastured	10	13	11	10	15	16
Woods pastured	9	12	6	7	4	7
Permanent pasture	46	46	19	16	22	37
Other land pastured throughout season	3	2	2	4	2	2
Farmstead, roads, fences	5	7	6	6	5	6
Other land	5	10	8	9	18	10
Total operated	149	168	112	124	128	143

Of the total acres in regular and special farms, 49 per cent was used for the production of crops, 9 per cent was in woods not pastured, 32 per cent was used for pasture, 4 per cent was occupied by farmsteads, roads, and fences, and 6 per cent was left idle.

The Grade A farms were mostly in Dryden and Groton Townships, where a larger proportion of the land was unsuitable for cropping, and therefore used for pasture, than on the other dairy and the miscellaneous-type farms. Some land that might have been used as pasture was left idle on farms which kept only a small amount of livestock.

CROPS

Of the total acreage in crops, 17 per cent was occupied by corn for grain, corn for silage, potatoes, cabbage, and field beans on the Grade A farms, as compared with 15 per cent on the Grade B farms, 11 per cent on the other dairy farms, 13 per cent on the poultry farms, 12 per cent on the miscellaneous-type farms, and 14 per cent on the special farms (table 7). Practically all of the corn on the Grade A and Grade B farms was grown for silage; on the farms where dairying was less important, corn was grown chiefly for grain.

Oats, or oats and barley, are commonly used as nurse crops for hay seedings. Buckwheat, since it is one of the few crops that can be put in late in the season—near the end of June or the first part of July—and still mature before frost in the fall, is often planted on soil which is slow to drain in the spring. These crops, together with barley alone and wheat,

TABLE 7. ACREAGE, PRODUCTION, AND RELATIVE IMPORTANCE OF CROPS GROWN ON 544 FARMS, 1937*

	Farms growing crop	Average per farm, all farms		Proportion of total crop acres	Proportion of total productive-man-work units on crops
		Area	Total crop		
	131 Grade A farms				
	Number	*Acres*		*Per cent*	*Per cent*
Corn for silage	113	8.5	78 tons	12	25
Potatoes	112	2.3	401 bushels	3	14
Cabbage	51	1.3	12 tons	2	8
Total		12.1		17	47
Oats	27	2.1	50 bushels	3	2
Oats and barley	98	9.3	247 bushels	13	11
Buckwheat	46	3.8	75 bushels	5	5
Wheat	32	1.9	43 bushels	3	2
Total		17.1		24	20
Alfalfa	49	4.4	10 tons	6	4
Clover and mixed hay	109	18.6	30 tons	27	12
Timothy	71	14.4	18 tons	20	9
Total		37.4		53	25
Other crops		3.8		6	8
Total, all crops		70.4		100	100
	122 Grade B farms				
	Number	*Acres*		*Per cent*	*Per cent*
Corn for grain	54	2.1	65 bushels	3	7
Corn for silage	92	6.9	60 tons	9	21
Potatoes	92	1.2	156 bushels	2	7
Field beans	19	1.1	16 bushels	1	3
Total		11.3		15	38
Oats	46	3.4	73 bushels	4	4
Oats and barley	73	8.6	195 bushels	11	11
Buckwheat	69	6.8	133 bushels	9	8
Wheat	52	4.2	87 bushels	5	5
Total		23.0		29	28
Alfalfa	42	4.1	9 tons	5	4
Clover and mixed hay	101	15.5	23 tons	20	10
Timothy	88	20.7	27 tons	26	12
Total		40.3		51	26
Other crops		3.8		5	8
Total, all crops		78.4		100	100

*Acreages are shown only for those crops which amounted to 1.0 acre or more per farm.

(Table 7 is continued on the following page)

occupied 24 per cent of the total acres in crops on the Grade A farms, 29 per cent on the Grade B farms, 35 per cent on the other dairy farms, 46 per cent on the poultry farms, 40 per cent on the miscellaneous-type farms, and 32 per cent on the special farms.

Hay made up from 46 to 53 per cent of the total acres in crops on each type of farm, except on the poultry and the miscellaneous-type farms, where it occupied 37 and 40 per cent, respectively, of the total acres in

TABLE 7* (continued)

	Farms growing crop	Average per farm, all farms: Area	Average per farm, all farms: Total crop	Proportion of total crop acres	Proportion of total productive-man-work units on crops
	129 other dairy farms				
	Number	*Acres*		*Per cent*	*Per cent*
Corn for grain	50	3.7	117 bushels	6	15
Corn fodder	107	(2.8)	9 tons		
Field beans	42	2.7	44 bushels	5	8
Total		6.4		11	23
Oats	66	4.4	97 bushels	7	7
Barley	29	1.6	30 bushels	3	2
Oats and barley	36	2.8	82 bushels	5	4
Buckwheat	73	6.3	118 bushels	10	10
Wheat	78	6.2	182 bushels	10	9
Total		21.3		35	32
Alfalfa	33	3.4	6 tons	5	4
Clover and mixed hay	83	9.4	13 tons	16	8
Timothy	90	14.9	17 tons	25	11
Total		27.7		46	23
Apples	44	1.1	5 bushels	2	4
Other crops		4.1	....	6	18
Total, all crops		60.6		100	100
	40 poultry farms				
	Number	*Acres*		*Per cent*	*Per cent*
Corn for grain	23	4.1	147 bushels	6	16
Corn for silage	9	1.4	16 tons	2	4
Corn fodder	22	(3.0)	5 tons	..	
Potatoes	17	1.1	30 bushels	2	7
Field beans	7	2.4	47 bushels	3	6
Total		9.0		13	33
Oats	12	2.7	60 bushels	4	3
Barley	8	1.6	29 bushels	2	2
Oats and barley	20	6.9	161 bushels	10	6
Buckwheat	26	8.3	171 bushels	12	10
Wheat	32	13.1	286 bushels	18	20
Total		32.6		46	41
Alfalfa	15	5.6	12 tons	8	5
Clover and mixed hay	27	11.8	20 tons	16	9
Timothy	24	9.3	15 tons	10	5
Total		26.7		37	19
Other crops		3.1		4	7
Total, all crops		71.4		100	100

*Averages are shown only for those crops which amounted to 1.0 acre or more per farm.

(Table 7 is concluded on the following page)

crops. Timothy comprised more than 50 per cent of the total acreage in hay on the Grade B, other dairy, and miscellaneous-type farms. Alfalfa, or clover and mixed hay, was relatively more important on the other types of farms.

Work on intertilled crops made up approximately 47 per cent of the total work on crops on the Grade A farms, 38 per cent on the Grade B farms, TABLE 7* (*concluded*)

	Farms growing crop	Average per farm, all farms		Proportion of total crop acres	Proportion of total produc-tive-man-work units on crops
		Area	Total crop		
	31 miscellaneous-type farms				
	Number	*Acres*		*Per cent*	*Per cent*
Corn for grain	20	3.0	109 bushels	5	11
Corn fodder	23	(2.3)	5 tons	. .	. .
Potatoes	28	2.1	206 bushels	3	13
Field beans	10	2.2	40 bushels	4	6
Total		7.3		12	30
Oats	7	1.9	44 bushels	3	2
Barley	5	2.6	52 bushels	4	3
Oats and barley	10	3.7	82 bushels	6	5
Buckwheat	18	9.5	169 bushels	15	12
Wheat	15	7.5	162 bushels	12	10
Total		25.2		40	32
Alfalfa	8	2.2	6 tons	4	3
Clover and mixed hay	18	8.3	9 tons	13	5
Timothy	22	14.6	18 tons	23	9
Total		25.1		40	17
Grapes	2	1.1	2 tons	2	8
Other crops		3.6		6	13
Total, all crops		62.3		100	100
	91 special farms				
	Number	*Acres*		*Per cent*	*Per cent*
Corn for grain	43	1.8	49 bushels	3	7
Corn for silage	42	4.4	41 tons	6	15
Corn fodder	. .	(1.3)	3 tons	. .	. .
Potatoes	67	1.9	262 bushels	3	13
Field beans	11	1.2	17 bushels	2	3
Total		9.3		14	38
Oats	28	2.5	44 bushels	4	3
Barley	11	1.1	24 bushels	2	1
Oats and barley	48	6.3	165 bushels	10	9
Buckwheat	42	6.9	132 bushels	10	9
Wheat	34	4.2	93 bushels	6	6
Total		21.0		32	28
Alfalfa	29	3.1	7 tons	5	4
Clover and mixed hay	68	13.4	20 tons	21	10
Timothy	58	15.1	19 tons	23	10
Total		31.6		49	24
Other crops		3.2		5	10
Total, all crops		65.1		100	100

*Acreages are shown only for those crops which amounted to 1.0 acre or more per farm.

25 per cent on the other dairy farms, 33 per cent on the poultry farms, 30 per cent on the miscellaneous-type farms, and 38 per cent on the special farms. Work on small grains was 20 per cent of the total work on crops on the Grade A farms, 28 per cent on the Grade B farms, 32 per cent on the other dairy farms, 41 per cent on the poultry farms, 32 per cent on the miscellaneous-type farms, and 28 per cent on the special farms. Work on hay

crops was approximately one-fourth of the total amount of work on crops on every type of farm except the poultry and miscellaneous-type farms, where it amounted to 19 and 17 per cent, respectively.

Total work units on crops on the respective types of farms were: 167, or 38 per cent of the total work units on all enterprises, on the Grade A farms; 166, or 40 per cent, on the Grade B farms; 133, or 54 per cent, on the other dairy farms; 158, or 40 per cent, on the poultry farms; 158, or 64 per cent, on the miscellaneous-type farms; and 150, or 30 per cent, on the special farms (table 8).

TABLE 8. DISTRIBUTION OF PRODUCTIVE-MAN-WORK UNITS, BY TYPES OF FARMING, 544 FARMS, 1937

	Grade A farms	Grade B farms	Other dairy farms	Poultry farms	Miscel-laneous-type farms	Special farms
Number of farms	131	122	129	40	31	91
	Productive-man-work units					
Cows	233	204	69	89	40	131
Other animals except work animals	32	36	34	144	38	49
Total livestock	265	240	103	233	78	180
Crops	167	166	133	158	158	150
Miscellaneous	10	12	11	5	12	165
Total productive-man-work units	442	418	247	396	248	495

Potatoes, cabbage, field beans, buckwheat, and wheat were the chief crops that were produced for sale. More than 50 per cent of all the cabbage, field beans, and buckwheat which was produced in the area, was sold.

TABLE 9. SALE OF CROPS IN PER CENT OF TOTAL PRODUCTION, 544 FARMS, 1937

	Grade A farms	Grade B farms	Other dairy farms	Poultry farms	Miscel-laneous-type farms	Total regular farms	Special farms
Number of farms	131	122	129	40	31	453	91
	Proportion of total crop sold						
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Corn for grain	3.7	1.6	14.3	2.7	16.1	8.3	11.8
Potatoes	69.1	48.1	47.8	55.9	62.0	61.1	67.8
Cabbage	95.2	95.0	99.1	95.7	98.1	95.7	98.0
Field beans	96.5	97.4	94.9	99.8	95.4	96.3	96.4
Barley	13.1	15.9	29.6	22.8	62.1	29.0	31.3
Buckwheat	54.2	53.3	66.2	62.0	77.5	60.6	62.2
Wheat	36.6	43.6	52.2	27.5	60.7	43.8	32.1
Alfalfa (all cuttings)	4.5	7.7	32.8	42.4	68.8	18.4	7.8
Clover hay (all cuttings)	7.2	8.0	26.5	28.5	20.4	13.0	12.0
Timothy hay	21.7	27.7	33.2	23.3	53.6	28.9	27.9
Grapes	...	...	100.0	...	100.0	100.0	

CROP YIELDS

The yields of the most important crops for each type of farming are shown in table 10. Corn for silage, potatoes, oats and barley, and hay yields showed more variation from one type of farming to another than did the yields of the other crops. Except for potatoes, which were lower on the poultry farms, the yields of all these crops except alfalfa were highest on the Grade A and poultry farms and lowest on the other dairy farms.

TABLE 10. YIELDS OF IMPORTANT CROPS GROWN ON 544 FARMS, 1937

	Unit	Grade A farms	Grade B farms	Other dairy farms	Poultry farms	Miscellaneous-type farms	Special farms
Number of farms	......	131	122	129	40	31	91
		Yield of crops					
Corn for grain	Bushels	43	32	32	36	36	27
Corn for silage	Tons	9.2	8.8	6.2	11.2	....	9.5
Corn fodder	Tons	6.5	3.7	4.0	4.0	2.2	4.6
Potatoes	Bushels	172	130	108	57	100	138
Cabbage	Tons	9.2	9.3	8.8	16.3	5.7	10.2
Field beans	Bushels	15	15	16	19	18	14
Oats	Bushels	24	22	21	22	24	18
Barley	Bushels	19	23	19	18	20	22
Oats and barley	Bushels	26	23	18	23	22	26
Buckwheat	Bushels	20	20	19	21	18	19
Wheat	Bushels	23	21	21	22	22	22
Alfalfa	Tons	2.3	2.2	1.7	2.1	2.6	2.4
Clover and mixed hay	Tons	1.6	1.5	1.3	1.4	1.1	1.5
Timothy	Tons	1.2	1.3	1.1	1.3	1.2	1.3

FACTORS AFFECTING CROP YIELDS

The type of soil, local weather conditions, fertility practices, and various other factors, are important in determining crop yields. In general, the farms that had the highest crop yields applied more fertilizer per acre fertilized, and had more manure available per acre of crops, than did the farms with lower yields (table 11).

On the Grade A farms, the value of fertilizer applied per acre fertilized and the amount of manure available per acre was more than it was on either the Grade B or the other dairy farms. The Grade A farms had yields that were 107 per cent of the average yields for the region, as compared with 98 per cent on the Grade B farms, 90 per cent on the other dairy farms, 98 per cent on the poultry farms, 89 per cent on the miscellaneous-type farms, and 96 per cent on the special farms.

LIVESTOCK

As measured by productive-man-work units and the proportion which work units on livestock were of the total work units, livestock was most important on the Grade A, Grade B, and poultry farms. Work units on livestock on the respective types of farms were: 265, or 60 per cent of the total work units, on the Grade A farms; 240, or 57 per cent, on the Grade B farms; 103, or 42 per cent, on the other dairy farms; 233, or 59 per cent, on the poultry farms; 78, or 31 per cent, on the miscellaneous-type farms;

TABLE 11. RELATION OF FERTILITY MAINTENANCE TO CROP YIELDS AND OTHER FACTORS, 342 FARMS, 1937

	Crop index			
	Less than 80	80–99	100–119	120 or more
	Grade A farms			
Number of farms	21	34	47	36
Acres of crops	81.6	82.6	86.9	75.4
Acres fertilized	21.0	24.7	18.8	26.9
Value of fertilizer	$66	$77	$67	$118
Value of fertilizer per acre fertilized	$2.82	$3.08	$3.43	$4.21
Manure per acre of crops (tons)	2.0	2.5	2.8	2.8
Crop index	72	90	108	143
	Grade B farms			
Number of farms	22	47	33	20
Acres of crops	71.7	81.5	89.3	90.4
Acres fertilized	19.5	27.2	38.2	37.0
Value of fertilizer	$50	$64	$117	$122
Value of fertilizer per acre fertilized	$2.80	$2.37	$3.05	$3.30
Manure per acre of crops (tons)	2.3	1.9	2.1	2.5
Crop index	66	90	109	136
	Other dairy farms			
Number of farms	43	57	33	12
Acres of crops	63.5	74.7	61.6	52.9
Acres fertilized	20.0	24.5	22.7	21.7
Value of fertilizer	$43	$62	$62	$65
Value of fertilizer per acre fertilized	$2.13	$2.50	$2.23	$3.01
Manure per acre of crops (tons)	1.1	1.3	1.6	1.3
Crop index	63	89	108	136
	Special farms			
Number of farms	24	34	12	19
Acres of crops	37.9	65.8	97.1	86.5
Acres fertilized	13.5	23.1	43.0	34.7
Value of fertilizer	$41	$65	$153	$143
Value of fertilizer per acre fertilized	$3.14	$2.58	$2.66	$4.13
Manure per acre of crops (tons)	1.0	1.3	1.3	2.2
Crop index	63	86	108	148
	Crop index			
	Less than 100	100 or more	Less than 100	100 or more
	Poultry farms		Miscellaneous type farms	
Number of farms	18	22	22	9
Acres of crops	99.1	131.2	113.6	170.0
Acres fertilized	11.7	46.8	14.3	47.8
Value of fertilizer	$36	$153	$43	$172
Value of fertilizer per acre fertilized	$2.64	$1.83	$3.01	$3.68
Manure per acre of crops (tons)	1.2	3.2	0.7	0.3
Crop index	71	118	73	128

and 180, or 36 per cent, on the special farms (table 8, page 14). On the Grade A and Grade B farms, practically all of the work units on livestock were on cows. On the poultry farms, work units on livestock other than cows were more than those on cows.

The average number of cows kept on the Grade A farms was 15.6, as compared with 13.5 on the Grade B farms, 4.4 on the other dairy farms, 5.9 on the poultry farms, 2.7 on the miscellaneous-type farms, and 8.6 on the special farms (table 12). For the regular and the special farms combined, 45 per cent of the cows were on farms which had a Grade A market for milk, and 35 per cent were on farms which had a Grade B market for milk.

TABLE 12. NUMBER OF LIVESTOCK KEPT, BY TYPES OF FARMING, 544 FARMS, 1937

	131 Grade A farms	122 Grade B farms	129 other dairy farms	40 poultry farms	31 miscellaneous-type farms	91 special farms
	Average number per farm					
Cows	15.6	13.5	4.4	5.9	2.7	8.6
Heifers 1 year or over	4.0	3.6	1.6	2.3	1.3	2.7
Heifers under 1 year	3.9	3.3	1.6	1.8	0.9	2.5
Bulls	0.9	0.9	0.4	0.4	0.3	0.7
Beef cattle	0.1	0.0	0.2	0.1	0.6	0.1
Horses	2.6	2.8	2.2	2.1	2.1	2.1
Mules	0.1	0.0	0.0	0.1	0.1	0.1
Colts	0.1	0.2	0.1	0.1	0.1	0.1
Ewes	1.3	1.2	5.2	4.6	8.5	2.9
Brood sows	0.1	0.2	0.5	0.1	0.3	0.3
Hens and pullets	57.7	92.9	97.6	655.8	120.7	155.8

Both the Grade A and the Grade B farms kept approximately one heifer for every two cows. On farms where dairying is less important in the farm organization, more heifers were kept in proportion to the average number of cows. Miscellaneous-type farms kept one heifer for every cow kept. Practically all of the Grade A and Grade B farms kept bulls. Less than half of the other farms had bulls.

Most of the farms kept one team of horses, and a few farms kept more than this. The average number of horses and mules was 2.7 on the Grade A farms, 2.8 on the Grade B farms, 2.2 on the other dairy farms, 2.2 on the poultry farms, 2.2 on the miscellaneous-type farms, and 2.2 on the special farms.

The average number of ewes kept was 1.3 on the Grade A farms, 1.2 on the Grade B farms, 5.2 on the other dairy farms, 4.6 on the poultry farms, 8.5 on the miscellaneous-type farms, and 2.9 on the special farms.

The average number of hens kept per farm was 58 on the Grade A farms, 93 on the Grade B farms, 98 on the other dairy farms, 656 on the poultry farms, 121 on the miscellaneous-type farms, and 156 on the special farms.

From 15 to 23 per cent of the other dairy, poultry, miscellaneous-type and special farms kept breeding ewes (table 13). Less than 10 per cent of the Grade A and Grade B farms kept breeding ewes.

About one-third, or 34 per cent, of the other dairy farms, 36 per cent of the miscellaneous-type farms, and 22 per cent of the special farms, kept brood sows. Not more than one-sixth of the farms of the other types kept brood sows, but approximately half or more than half of all the farms in each group kept hogs to butcher.

More sheep and hogs were kept on the miscellaneous-type farms than on any other type of farm.

The average distribution of capital in livestock for each type of farming

TABLE 13. PROPORTION OF FARMS IN EACH TYPE OF FARMING GROUP WHICH KEPT HOGS AND SHEEP, 544 FARMS, 1937

	131 Grade A farms	122 Grade B farms	129 other dairy farms	40 poultry farms	31 miscellaneous-type farms	91 special farms
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Ewes	8.4	8.2	17.1	15.0	22.6	15.4
Other sheep	6.1	7.4	13.2	7.5	22.6	14.3
Brood sows	9.9	14.8	34.1	7.5	35.5	22.0
Other hogs	55.0	53.3	67.4	47.5	58.1	67.0

is shown in table 14. The distribution of capital in livestock is approximately the same as the distribution of animal units. Most of the capital in livestock was in cows, work horses, and poultry.

TABLE 14. DISTRIBUTION OF CAPITAL IN LIVESTOCK, BY TYPES OF FARMING, 544 FARMS, 1937

	Average value per farm	Proportion of total livestock capital	Average value per farm	Proportion of total livestock capital	Average value per farm	Proportion of total livestock capital
	131 Grade A farms		122 Grade B farms		129 other dairy farms	
	Dollars	*Per cent*	*Dollars*	*Per cent*	*Dollars*	*Per cent*
Cows	1,417	62.4	1,191	57.9	318	33.8
Heifers 1 year or over	225	9.9	190	9.2	76	8.1
Heifers under 1 year	99	4.4	85	4.1	36	3.9
Bulls	71	3.1	69	3.4	21	2.3
Beef cattle	6	0.3	1	0.1	16	1.7
Horses	353	15.5	382	18.6	266	28.3
Mules	9	0.4	8	0.4	2	0.2
Colts	7	0.3	21	1.0	13	1.4
Ewes	13	0.6	10	0.5	47	5.0
Brood sows	4	0.2	7	0.3	16	1.7
Hens and pullets	58	2.6	85	4.1	101	10.7
Other livestock	9	0.3	8	0.4	29	2.9
Total	2,271	100.0	2,057	100.0	941	100.0
	40 poultry farms		31 miscellaneous-type farms		91 special farms	
	Dollars	*Per cent*	*Dollars*	*Per cent*	*Dollars*	*Per cent*
Cows	587	32.8	197	25.1	749	48.3
Heifers 1 year or over	143	8.0	56	7.2	142	9.2
Heifers under 1 year	44	2.4	15	2.0	55	3.5
Bulls	32	1.8	11	1.4	47	3.0
Beef cattle	3	0.2	28	3.5	5	0.3
Horses	289	16.1	246	31.4	274	17.7
Mules	2	0.1	9	1.1	13	0.8
Colts	4	0.2	11	1.4	7	0.5
Ewes	35	1.9	54	6.9	20	1.3
Brood sows	3	0.2	11	1.4	8	0.5
Hens and pullets	615	34.4	119	15.2	151	9.7
Other livestock	33	1.9	27	3.4	81	5.2
Total	1,790	100.0	784	100.0	1,552	100.0

FARM CAPITAL

Nearly one-fourth, or 23 per cent, of the farms in the regular group employed less than $5000 total capital. These farms were mostly the small dairies, which disposed of their milk in the form of cream, butter, veals, or some combination of these products, or farms that were classified as miscellaneous-type. Nearly one-third, or 30 per cent, employed as much as $10,000 capital or more. These farms were mostly the larger dairy farms, which sold Grade A or Grade B milk.

The average capital per farm was higher on the Grade A farms than on any of the other types of farms. It amounted to $10,479 per farm, as compared with $8969 on the Grade B farms, $6617 on the other dairy farms, $9210 on the poultry farms, $7129 on the miscellaneous-type farms, and $8751 on the special farms (table 15).

TABLE 15. CAPITAL PER FARM, BY TYPES OF FARMING, 544 FARMS, 1937

	Grade A farms	Grade B farms	Other dairy farms	Poultry farms	Miscellaneous-type farms	Special farms	All farms
Number of farms	131	122	129	40	31	91	544
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Capital in–							
Real estate	6,860	5,507	4,821	5,750	5,539	5,737	5,729
Livestock	2,271	2,057	941	1,790	784	1,552	1,667
Equipment	1,152	1,166	681	1,362	629	1,252	1,044
Feed and supplies	196	239	174	308	177	210	213
Total	10,479	8,969	6,617	9,210	7,129	8,751	8,653

When the work accomplished is considered in relation to the capital employed, it is seen that the Grade A farms had $24 in capital per productive-man-work unit, as compared with $21 on the Grade B farms, $27 on the other dairy farms, $23 on the poultry farms, $29 on the miscellaneous-type farms, and $18 on the special farms.

Capital per $100 of receipts on the Grade A farms amounted to $327, as compared with $358 on the Grade B farms, $517 on the other dairy farms, $232 on the poultry farms, $458 on the miscellaneous-type farms, and $259 on the special farms. It would take 3.3 years for the receipts to equal the capital on the Grade A farms, 3.6 years on the Grade B farms, 5.2 years on the other dairy farms, 2.3 years on the poultry farms, 4.6 years on the miscellaneous-type farms, and 2.6 years on the special farms.

Capital in real estate on the respective types of farms was, per farm: $6860, or 65 per cent of the total, on the Grade A farms; $5507, or 61 per cent of the total, on the Grade B farms; $4821, or 73 per cent of the total, on the other dairy farms; $5750, or 63 per cent of the total, on the poultry farms; $5539, or 78 per cent of the total, on the miscellaneous-type farms; and $5737, or 66 per cent of the total, on the special farms.

Capital in livestock per farm amounted to: $2271, or 22 per cent of the total, on the Grade A farms; $2057, or 23 per cent of the total, on the Grade B farms; $941, or 14 per cent of the total, on the other dairy farms; $1790, or 19 per cent of the total, on the poultry farms; $784, or 11 per cent of the total, on the miscellaneous-type farms; and $1552, or 18 per cent of the total, on the special farms.

The value of equipment per farm was only about half as much on the other dairy farms and the miscellaneous-type farms as it was on the farms having more livestock. The average value of equipment per farm was: $1152, or 11 per cent of the total capital per farm, on the Grade A farms; $1166, or 13 per cent of the total, on the Grade B farms; $681, or 10 per cent of the total, on the other dairy farms; $1362, or 15 per cent of the total, on the poultry farms; $629, or 9 per cent of the total, on the miscellaneous-type farms; and $1252, or 14 per cent of the total, on the special farms.

Feed and supplies made up a very small proportion of the total capital per farm on any of the types of farms. Only 3 per cent of the capital on the Grade B, other dairy, and poultry farms, and 2 per cent of that on the Grade A farms, the miscellaneous-type farms, and the special farms, was in feed and supplies.

Farms in the higher land classes employed more capital per farm and per man-work unit than did those in the lower land classes.

DISTRIBUTION OF CAPITAL IN REAL ESTATE

The average value of all real estate amounted to $5729 per farm. Of this amount, approximately 25 per cent was the value of the operator's house, 33 per cent was the value of other buildings, and 42 per cent was the value of the land. The distribution of capital in real estate did not vary greatly with the type of farming.

On farms where dairying was less important, fewer and less expensive buildings were required for housing livestock. These farms had relatively better houses, however, and the value of the land was less. Consequently, the value of other buildings made up about the same proportion of the total capital in real estate as on the more intensive dairy farms.

The distribution of capital in real estate did not vary greatly from one land class to another. Farms in land class II had 49 per cent of their real capital in land, as compared with 40 to 43 per cent in land classes III, IV, and V. Farms in land class IV had a slightly higher proportion of their real capital in buildings other than the operator's house, than did the farms in the other land classes.

FARM PRIVILEGES

The contributions of the farm toward family living are called "privileges." The value of privileges did not vary much with the type of farming. On every type of farm, the use of the house, milk, garden, and firewood were the most important contributions to the family living, from the standpoint of value (table 16). They represented approximately 75 per cent of the total value of privileges. Scarcely any milk was used in the form of butter on the farms producing market milk for fluid purposes.

If comparisons of any kind are to be made between farmers' incomes and incomes of men in other industries, the value of contributions by the business to the individual's living should be added to the amount of the wage or labor income.

RECEIPTS, EXPENSES, AND NET INCOME TO LABOR AND CAPITAL

The receipts, expenses, and various measures of net returns were summarized according to the type of farming followed.

In calculating the labor income, interest was charged against each farm on the amount of capital employed. In 1937, the most common rate of interest on long-term mortgage loans was 5 per cent. Since many farmers were actually paying interest on loans at approximately this rate, interest

TABLE 16. VALUE PER FARM OF PRIVILEGES FURNISHED TO OPERATORS, 544 FARMS, 1937

	Unit	Grade A farms		Grade B farms		Other dairy farms	
		Amount	Value	Amount	Value	Amount	Value
Number of farms	....	131	...	122	...	129	...
			Dollars		*Dollars*		*Dollars*
Milk	Quarts	1,378.0	58	1,442.0	60	1,074.4	48
Butter	Pounds	6.1	2	6.2	2	119.1	36
Eggs	Dozens	142.3	30	162.6	34	142.9	29
Pork	Pounds	276.6	29	270.5	28	262.4	28
Poultry, beef, and other livestock		.....	18	.....	21	.....	20
Potatoes	Bushels	27.7	11	28.4	13	23.0	11
Fruit		.....	2	.....	4	.....	6
Garden		.....	41	.....	46	.....	50
Wheat flour	Pounds	16.1	0	25.5	1	71.9	2
Buckwheat flour	Pounds	5.2	0	15.8	1	11.1	0
Honey	Pounds	0.6	0	0.8	0	1.7	0
Maple sirup	Gallons	0.5	1	0.1	0	0.1	0
Cider	Gallons	0.2	0	0.4	0	.....	...
Wood	Cords	28.1	54	35.4	66	28.3	53
Use of dwelling		.....	175	.....	151	.....	151
Total		.....	421	.....	427	.....	434

	Unit	Poultry farms		Miscellaneous farms		Special farms	
		Amount	Value	Amount	Value	Amount	Value
Number of farms	....	40	...	31	...	91	...
			Dollars		*Dollars*		*Dollars*
Milk	Quarts	1,356.1	63	856.8	40	1,222.4	60
Butter	Pounds	93.2	28	85.7	26	61.0	18
Cream	Pints	4.6	2	.....	...	.....	...
Eggs	Dozens	221.4	39	141.1	27	170.5	35
Pork	Pounds	198.5	20	221.6	22	281.7	29
Poultry, beef, and other livestock		.....	36	.....	18	.....	25
Potatoes	Bushels	16.2	8	22.6	10	26.2	12
Fruit		.....	7	.....	4	.....	3
Garden		.....	58	.....	48	.....	51
Wheat flour	Pounds	51.8	1	106.1	4	21.9	1
Buckwheat flour	Pounds	.....	...	6.5	0	12.6	1
Honey	Pounds	7.5	1	.....	...	0.7	0
Maple sirup	Gallons	.....	...	.....	...	0.1	0
Wood	Cords	22.0	43	33.1	60	26.6	46
Use of dwelling		.....	169	.....	162	.....	170
Total		.....	475	.....	421	.....	451

was charged on the entire amount of capital employed on each of the farms at the uniform rate of 5 per cent.

LABOR INCOME

The average labor income was $407 on the Grade A farms, –$28 on the Grade B farms, –$150 on the other dairy farms, $282 on the poultry farms, $29 on the miscellaneous-type farms, and $548 on the special farms (table 17).

The value of privileges which the farms furnished showed little variation with the type of farming followed (table 16). The labor earnings were higher than the labor incomes by about the same amount for each type of farming.

TABLE 17. LABOR INCOME AND OTHER FACTORS, BY TYPES OF FARMING, 544 FARMS, 1937

	Grade A farms	Grade B farms	Other dairy farms	Poultry farms	Miscel-laneous-type farms	Special farms
Number of farms	131	122	129	40	31	91
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Average farm capital	10,479	8,969	6,617	9,210	7,129	8,751
Receipts:						
Sales of livestock products	2,292	1,745	468	2,740	433	1,359
Livestock increase	302	247	251	512	240	333
Crop sales	357	308	438	515	731	402
Miscellaneous*	109	94	85	92	109	1,038
Increase in all other capital	146	110	39	113	45	241
Total	3,206	2,504	1,281	3,972	1,558	3,373
Total current expense*	2,275	2,083	1,100	3,230	1,173	2,387
Income from labor and capital	931	421	181	742	385	986
Interest on capital at 5 per cent	524	449	331	460	356	438
Labor income	407	–28	–150	282	29	548
Labor earnings	840	413	285	759	470	1,003
Value of operator's time	696	616	498	650	517	589
Return on capital	235	–195	–317	92	–132	397
Percentage return on capital	2.2	–2.2	–4.8	1.0	–1.9	4.5

*Cash rent not included.

RECEIPTS

Total receipts per farm were $3206 on the Grade A farms, $2504 on the Grade B farms, $1281 on the other dairy farms, $3972 on the poultry farms, $1558 on the miscellaneous-type farms, and $3373 on the special farms (table 17). This amounted to $31 per $100 in capital on the Grade A farms, $28 on the Grade B farms, $19 on the other dairy farms, $43 on the poultry farms, $22 on the miscellaneous-type farms, and $39 on the special farms.

Most of the miscellaneous income on the special farms (table 17) was obtained from work done off the farms. Salt mines, cement plants, and the typewriter factory at Groton, furnished work for many of the men on these farms. Others hauled milk, did custom threshing, or did other kinds of work more nearly related to farming.

Livestock products

The sale of livestock products furnished the most important part of the income on every type of farm except the miscellaneous-type farms. Receipts from the sale of livestock products made up 72 per cent of the total receipts per farm on the Grade A farms, 70 per cent of those on the Grade B farms, 36 per cent of those on the other dairy farms, 69 per cent of those on the poultry farms, 28 per cent of those on the miscellaneous-type farms, and 40 per cent of those on the special farms (table 18). Less than $500 worth of livestock products were sold per farm on the other dairy farms and the miscellaneous-type farms. Receipts from this source were approximately three to six times as large on the other groups of farms.

Market milk and eggs were the principal livestock products sold (table

19). On farms where dairying was less intensive, cream and butter sales took the place of market-milk sales.

Details concerning the sale of market milk were obtained on 127 Grade A farms and 122 Grade B farms. Of the total receipts on all the regular farms, 45 per cent was from the sale of market milk.

On the 127 Grade A farms, the average sales of fluid milk were 932 hundredweight per farm (table 20). Sales of milk were lowest during August and September; approximately 13 per cent of the total sales for the year were made during these months. Milk sales were highest in May and June; about 20 per cent of the total milk sales for the year were made in these months. The average price received, including premiums, was $2.30 per hundredweight. The highest prices were received in November and December and the lowest prices were received in May and June. The average butterfat test for the milk sold on these farms was 4.0 per cent.

TABLE 18. Receipts per Farm, 544 Farms, 1937

	Farms on which products were sold	Value per farm, all farms	Proportion of receipts	Farms on which products were sold	Value per farm, all farms	Proportion of receipts	Farms on which products were sold	Value per farm, all farms	Proportion of receipts
	131 Grade A farms			122 Grade B farms			129 other dairy farms		
	Number	*Dollars*	*Per cent*	*Number*	*Dollars*	*Per cent*	*Number*	*Dollars*	*Per cent*
Livestock products:									
Milk wholesaled	131	2,152	67.1	122	1,504	60.1	1	0	0.0
Cream wholesaled	2	0	0.0	3	2	0.1	62	92	7.2
Milk retailed	21	17	0.5	21	11	0.5	28	33	2.6
Butter	...	...	...	3	1	0.0	55	66	5.1
Wool	12	5	0.2	9	3	0.1	20	14	1.1
Eggs	82	117	3.7	96	223	8.9	102	254	19.8
Other livestock products	6	1	0.0	11	1	0.0	17	9	0.7
Total livestock products		2,292	71.5		1,745	69.7		468	36.5
Livestock increase		302	9.4		247	9.9		251	19.6
Crop sales:									
Corn for grain	2	5	0.2	2	1	0.0	11	40	3.1
Potatoes	96	113	3.5	54	33	1.3	69	21	1.6
Cabbage	45	108	3.4	18	64	2.6	9	22	1.7
Field beans	7	7	0.2	17	31	1.2	36	84	6.6
Factory peas	10	17	0.5	5	8	0.3	3	5	0.4
Barley	2	1	0.0	4	3	0.1	7	7	0.6
Buckwheat	24	25	0.8	38	47	1.9	39	53	4.1
Wheat	12	15	0.5	23	38	1.5	39	69	5.4
Straw	10	3	0.1	12	6	0.2	25	10	0.8
Alfalfa (all cuttings)	...	4	0.1	...	7	0.3	...	17	1.3
Clover hay (all cuttings)	...	11	0.3	...	11	0.5	...	26	2.0
Timothy hay	24	22	0.7	38	48	1.9	33	39	3.1
Grapes	...	...	...	...	...	...	1	0	0.0
All other crops	...	26	0.8	...	11	0.5	...	45	3.5
Total crops		357	11.1		308	12.3		438	34.2
Miscellaneous receipts		109	3.4		94	3.7		85	6.6
Increase in all other capital		146	4.6		110	4.4		39	3.1
Total receipts		3,206	100.0		2,504	100.0		1,281	100.0

(Table 18 is concluded on the following page)

TABLE 18 (*concluded*)

	Farms on which products were sold	Value per farm, all farms	Proportion of receipts	Farms on which products were sold	Value per farm, all farms	Proportion of receipts	Farms on which products were sold	Value per farm, all farms	Proportion of receipts
	40 poultry farms			31 miscellaneous-type farms			91 special farms		
	Number	*Dollars*	*Per cent*	*Number*	*Dollars*	*Per cent*	*Number*	*Dollars*	*Per cent*
Livestock products:									
Milk wholesaled	12	567	14.3	...	...	...	42	838	24.8
Cream wholesaled	14	43	1.1	9	51	3.3	22	41	1.2
Milk retailed	9	56	1.4	6	14	0.9	16	54	1.6
Butter	12	16	0.4	9	52	3.3	13	12	0.4
Wool	6	16	0.4	7	20	1.3	13	9	0.3
Eggs	40	2,041	51.4	20	296	19.0	60	403	11.9
Other livestock products	3	1	0.0	...	...	...	6	2	0.1
Total livestock products		2,740	69.0		433	27.8		1,359	40.3
Livestock increase		512	12.9		240	15.4		333	9.9
Crop sales:									
Corn for grain	1	2	0.0	2	22	1.4	6	3	0.1
Potatoes	10	32	0.8	21	60	3.9	45	72	2.1
Cabbage	5	42	1.1	7	39	2.5	19	87	2.6
Field beans	7	85	2.1	9	80	5.1	9	40	1.2
Factory peas	1	4	0.1	...	...	...	2	2	0.1
Barley	2	7	0.2	1	24	1.5	4	7	0.2
Buckwheat	10	63	1.6	13	87	5.6	27	62	1.8
Wheat	10	75	1.9	10	94	6.0	16	30	0.9
Straw	11	25	0.6	6	32	2.1	10	6	0.2
Alfalfa (all cuttings)	...	54	1.4	...	48	3.1	...	5	0.2
Clover hay (all cuttings)	...	41	1.0	...	15	1.0	...	21	0.6
Timothy hay	7	14	0.4	7	57	3.6	35	32	0.9
Grapes	...	...	...	2	102	6.5	...	...	...
All other crops	...	71	1.8	...	71	4.6	...	35	1.0
Total crops		515	13.0		731	46.9		402	11.9
Miscellaneous receipts		92	2.3		109	7.0		1,038	30.7
Increase in all other capital		113	2.8		45	2.9		241	7.2
Total receipts		3,972	100.0		1,558	100.0		3,373	100.0

TABLE 19. LIVESTOCK PRODUCTS SOLD, BY TYPES OF FARMING, 544 FARMS, 1937

	Farms on which products were sold	Average sales per farm		Farms on which products were sold	Average sales per farm	
		Amount	Value		Amount	Value
	131 Grade A farms			122 Grade B farms		
	Number		*Dollars*	*Number*		*Dollars*
Milk wholesaled...	131	93,569 pounds	2,152	122	77,089 pounds	1,504
Cream wholesaled.	1	1 pound butterfat	0	3	7 pounds butterfat	2
Milk retailed......	21	208 quarts	17	21	159 quarts	11
Cream retailed....	1	0	0	...	....	...
Butter...........	...	....	....	3	3 pounds	1
Wool............	12	11 pounds	5	9	7 pounds	3
Eggs............	84	495 dozens	117	97	882 dozens	223
Breeding fees......	5	0	1	9	1 head	1
Honey..........	1	1 pound	0	2	1 pound	0
Total.........			2,292			1,745
	129 other dairy farms			40 poultry farms		
	Number		*Dollars*	*Number*		*Dollars*
Milk wholesaled...	1	11 pounds	0	12	24,580 pounds	567
Cream wholesaled	61	324 pounds butterfat	92	13	90 pounds butterfat	25
Milk retailed......	28	405 quarts	33	9	980 quarts	56
Cream retailed....	1	0	0	1	33 quarts	18
Butter..........	55	204 pounds	66	12	50 pounds	16
Other dairy products..........	7	....	2	...	....	...
Wool............	20	41 pounds	14	6	43 pounds	16
Eggs............	105	994 dozens	254	40	7,632 dozens	2,041
Breeding fees......	6	1 head	1	2	....	1
Honey..........	4	68 pounds	6	1	2 pounds	0
Total........			468			2,740
	31 miscellaneous-type farms			91 special farms		
	Number		*Dollars*	*Number*		*Dollars*
Milk wholesaled...	...	....	...	42	38,358 pounds	838
Cream wholesaled	7	85 pounds butterfat	24	21	145 pounds butterfat	41
Milk retailed......	6	186 quarts	14	16	535 quarts	54
Cream retailed....	3	63 quarts	27	1	....	0
Butter..........	9	155 pounds	52	13	40 pounds	12
Other dairy products..........	...	....	...	1	....	0
Wool............	7	57 pounds	20	13	23 pounds	9
Eggs............	21	1,157 dozens	296	62	1,601 dozens	403
Breeding fees......	...	....	...	3	....	2
Honey..........	...	....	...	2	4 pounds	0
Total........			433			1,359

TABLE 20. MARKET MILK SOLD, 127 GRADE A FARMS, 1937–38*

Month	Milk sold wholesale per farm	Proportion of milk sold each month	Fat	Butterfat test of milk	Value of milk sold, excluding premiums, per farm	Price received, excluding premiums, per hundredweight	Grade A premiums		Value of milk sold, including premiums, per farm	Price received, including premiums, per hundredweight
							Value per farm	Per hundredweight		
	Pounds	*Per cent*	*Pounds*	*Per cent*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1937:										
April	8,944	9.6	357	4.0	164	1.83	19	0.21	183	2.04
May	9,695	10.4	392	4.0	166	1.72	20	0.20	186	1.92
June	9,327	10.0	373	4.0	155	1.66	17	0.18	172	1.84
July	7,535	8.1	303	4.0	140	1.87	18	0.23	158	2.10
August	6,072	6.5	248	4.1	124	2.05	16	0.25	140	2.30
September	6,157	6.6	252	4.1	136	2.20	17	0.29	153	2.49
October	6,994	7.5	289	4.1	162	2.31	20	0.29	182	2.60
November	7,003	7.5	286	4.1	181	2.60	24	0.33	205	2.93
December	7,579	8.1	309	4.1	189	2.50	21	0.27	210	2.77
1938:										
January	7,966	8.6	322	4.0	182	2.29	19	0.24	201	2.53
February	7,476	8.0	296	4.0	157	2.10	16	0.21	173	2.31
March	8,482	9.1	337	4.0	165	1.94	17	0.20	182	2.14
Total	93,230	100.0	3,764	4.0	1,921	2.06	224	0.24	2,145	2.30

*The distribution of milk sales was not ascertained for the other 4 farms classified as Grade A farms.

On the 122 Grade B farms, sales of milk averaged 771 hundredweight per farm (table 21). The monthly distribution of these sales was approximately the same as on the 127 Grade A farms. The average price received was $1.95 per hundredweight. The average butterfat test was 3.9 per cent.

TABLE 21. MARKET MILK SOLD, 122 GRADE B FARMS, 1937–38

Month	Milk sold wholesale per farm	Proportion of milk sold each month	Fat	Butterfat test of milk	Value of milk sold per farm	Price received for milk per hundredweight
	Pounds	*Per cent*	*Pounds*	*Per cent*	*Dollars*	*Dollars*
1937:						
April	7,022	9.1	269	3.8	120	1.70
May	8,114	10.5	311	3.8	125	1.54
June	7,895	10.3	301	3.8	117	1.49
July	6,436	8.4	248	3.9	110	1.71
August	5,242	6.8	205	3.9	105	2.00
September	5,623	7.3	224	4.0	124	2.21
October	6,124	7.9	244	4.0	140	2.28
November	5,778	7.5	228	4.0	145	2.52
December	6,106	7.9	239	3.9	148	2.42
1938:						
January	6,226	8.1	242	3.9	135	2.17
February	5,949	7.7	228	3.8	118	1.98
March	6,574	8.5	250	3.8	117	1.77
Total	77,089	100.0	2,989	3.9	1,504	1.95

Crop sales

The sale of crops was second to the sale of livestock products as a source of income on most of the different types of farms. Income from this source ranged from $308 per farm on the Grade B farms, to $731 on the miscellaneous-type farms (table 22). As a proportion of the total receipts per farm, crop sales were 11 per cent of the total on the Grade A farms, 12 per cent on the Grade B farms, 34 per cent on the other dairy farms, 13 per cent on the poultry farms, 47 per cent on the miscellaneous-type farms, and 12 per cent on the special farms.

TABLE 22. SALES OF CROPS, 544 FARMS, 1937

	Farms selling crops	Average sales per farm		Farms selling crops	Average sales per farm	
		Amount	Value		Amount	Value
	131 Grade A farms			122 Grade B farms		
	Number		*Dollars*	*Number*		*Dollars*
Corn for grain*	2	1.4 bushels	5	2	1.1 bushels	1
Potatoes	96	276.8 bushels	113	54	75.3 bushels	33
Cabbage	45	11.2 tons	108	18	4.8 tons	64
Field beans	7	3.2 bushels	7	17	15.5 bushels	31
Factory peas	10	0.3 ton	17	5	0.1 ton	8
Barley	2	0.9 bushel	1	4	3.4 bushels	3
Buckwheat	24	40.7 bushels	25	38	70.9 bushels	47
Wheat	12	15.7 bushels	15	23	38.1 bushels	38
Straw	10	0.6 ton	3	12	1.0 ton	6
Alfalfa (all cuttings)	5	0.5 ton	4	9	0.7 ton	7
Clover hay (all cuttings)	19	2.1 tons	11	18	1.8 tons	11
Timothy hay	24	3.9 tons	22	38	7.4 tons	48
Grapes	..	....	..	..	....	..
All other crops	..	....	26	..	....	11
Total	..	....	357	..	....	308
	129 other dairy farms			40 poultry farms		
	Number		*Dollars*	*Number*		*Dollars*
Corn for grain*	11	16.8 bushels	40	1	4.0 bushels	2
Potatoes	69	45.9 bushels	21	10	33.3 bushels	32
Cabbage	9	2.1 tons	22	5	5.0 tons	42
Field beans	36	41.7 bushels	84	7	46.5 bushels	85
Factory peas	3	0.1 ton	5	1	0.1 ton	4
Barley	7	8.8 bushels	7	2	6.5 bushels	7
Buckwheat	39	78.6 bushels	53	10	106.1 bushels	63
Wheat	39	68.9 bushels	69	10	78.5 bushels	75
Straw	25	1.5 tons	10	11	4.0 tons	25
Alfalfa (all cuttings)	15	1.9 tons	17	8	5.0 tons	54
Clover hay (all cuttings)	27	3.3 tons	26	9	5.6 tons	41
Timothy hay	33	5.6 tons	39	7	2.3 tons	14
Grapes	1	....	0	..	....	..
All other crops	..	....	45	..	....	71
Total	..	....	438	..	....	515
	31 miscellaneous-type farms			91 special farms		
	Number		*Dollars*	*Number*		*Dollars*
Corn for grain*	2	17.7 bushels	22	6	5.8 bushels	3
Potatoes	21	127.6 bushels	60	45	177.5 bushels	72
Cabbage	7	3.3 tons	39	19	8.8 tons	87
Field beans	9	38.0 bushels	80	9	16.2 bushels	40
Factory peas	..	....	..	2	....	2
Barley	1	32.3 bushels	24	4	7.5 bushels	7
Buckwheat	13	130.8 bushels	87	27	82.1 bushels	62
Wheat	10	98.1 bushels	94	16	29.9 bushels	30
Straw	6	4.4 tons	32	10	1.0 ton	6
Alfalfa (all cuttings)	4	3.8 tons	48	29	0.6 ton	5
Clover hay (all cuttings)	3	1.8 tons	15	68	2.4 tons	21
Timothy hay	7	9.8 tons	57	35	5.4 tons	32
Grapes	2	1.7 tons	102	..	....	..
All other crops	..	....	71	..	....	35
Total	..	....	731	..	....	402

*Includes corn for seed.

EXPENSES

Expenses were $2275 per farm on the Grade A farms, $2083 on the Grade B farms, $1100 on the other dairy farms, $3230 on the poultry farms, $1173 on the miscellaneous-type farms, and $2387 on the special farms (table 23). They amounted to $5.15 per man-work unit on the Grade A farms, $4.98 on the Grade B farms, $4.45 on the other dairy farms, $8.16

TABLE 23. EXPENSES PER FARM, BY TYPES OF FARMING, 544 FARMS, 1937

	Expenses per farm	Proportion of total expenses	Expenses per farm	Proportion of total expenses	Expenses per farm	Proportion of total expenses
	131 Grade A farms		122 Grade B farms		129 other dairy farms	
Labor:	*Dollars*	*Per cent*	*Dollars*	*Per cent*	*Dollars*	*Per cent*
Hired month help	213	9.4	131	6.3	50	4.5
Hired day help	41	1.8	49	2.4	31	2.8
Unpaid labor	109	4.8	139	6.7	87	7.9
Board of hired month help	60	2.6	47	2.3	20	1.9
Board of hired day help	9	0.4	5	0.2	7	0.6
Board of unpaid labor	41	1.8	57	2.7	32	2.9
Total for labor	473	20.8	428	20.6	227	20.6
Livestock expense:						
Concentrated feed for–						
Cattle	450	19.8	326	15.6	47	4.2
Poultry	87	3.8	125	6.0	126	11.5
Other livestock	27	1.2	31	1.5	12	1.1
Salt	4	0.2	4	0.2	2	0.2
Feed-grinding	10	0.4	10	0.5	6	0.6
Hay and silage	24	1.0	11	0.5	6	0.6
Pasturage	4	0.2	4	0.2	1	0.1
Rent of pasture land	4	0.2	1	0.1	1	0.0
Bedding	3	0.1	2	0.1	1	0.0
Total feed and bedding	613	26.9	514	24.7	202	18.3
Other livestock expense:						
Cow-testing	2	0.1	2	0.1	0	0.0
Registration fees	1	0.1	1	0.0	0	0.0
Breeding fees	1	0.0	1	0.1	2	0.2
Veterinary fees, medicine, and disinfectants	21	0.9	20	1.0	5	0.5
Horseshoeing	9	0.4	8	0.4	4	0.4
Sheep-shearing	0	0.0	1	0.0	1	0.1
Total other livestock expense	34	1.5	33	1.6	12	1.2
Total for livestock	647	28.4	547	26.3	214	19.5
Machinery and equipment:						
Automobile	81	3.6	83	4.0	62	5.6
New machinery	177	7.8	142	6.8	81	7.4
Truck	40	1.7	23	1.1	13	1.2
Tractor	50	2.2	50	2.4	37	3.4
Repairs	24	1.1	26	1.2	14	1.3
Fuel and lubrication	7	0.3	7	0.3	4	0.4
Milk bottles, cans, etc.	36	1.6	24	1.2	1	0.0
Total	415	18.3	355	17.0	212	19.3
Hired machinery:						
Silo-filling	9	0.4	9	0.4	1	0.1
Baling	3	0.1	6	0.3	11	1.0
Threshing	20	0.9	23	1.1	21	1.9
Milk-hauling	76	3.3	86	4.2	0	0.0
Other machinery	9	0.4	11	0.5	9	0.8
Total hired machinery	117	5.1	135	6.5	42	3.8
Total for machinery and equipment	532	23.4	490	23.5	254	23.1

(Table 23 is continued on the following page)

TABLE 23 (*continued*)

	Expenses per farm	Proportion of total expenses	Expenses per farm	Proportion of total expenses	Expenses per farm	Proportion of total expenses
	131 Grade A farms		122 Grade B farms		129 other dairy farms	
Buildings:	*Dollars*	*Per cent*	*Dollars*	*Per cent*	*Dollars*	*Per cent*
New buildings	72	3.2	83	4.0	22	1.9
Building repairs	97	4.2	112	5.4	82	7.5
Total for buildings	169	7.4	195	9.4	104	9.4
Fences	14	0.6	16	0.7	9	0.8
Fire insurance	33	1.5	32	1.5	22	2.0
Taxes	121	5.3	125	6.0	101	9.2
Crop expense:						
Seeds and plants	78	3.4	79	3.7	58	5.3
Fertilizer	86	3.8	85	4.1	56	5.0
Lime	25	1.1	17	0.8	5	0.5
Spray materials	7	0.3	1	0.1	1	0.1
Total crop expense	196	8.6	182	8.7	120	10.9
Miscellaneous expense:						
Electricity and lighting plant	29	1.3	12	0.6	3	0.3
Telephone	12	0.5	6	0.3	6	0.5
Twine	7	0.3	9	0.4	5	0.5
Ice	7	0.3	5	0.3	0	0.0
Other miscellaneous expense	35	1.6	36	1.7	35	3.2
Total miscellaneous expense	90	4.0	68	3.3	49	4.5
Total	2,275	100.0	2,083	100.0	1,100	100.0
Cash rent	37		26		16	
Total including cash rent	2,312		2,109		1,116	
	40 poultry farms		31 miscellaneous-type farms		91 special farms	
Labor:	*Dollars*	*Per cent*	*Dollars*	*Per cent*	*Dollars*	*Per cent*
Hired month help	150	4.6	70	5.9	206	8.7
Hired day help	44	1.3	29	2.5	55	2.3
Unpaid labor	148	4.6	61	5.2	131	5.5
Board of hired month help	52	1.6	20	1.7	56	2.3
Board of hired day help	9	0.3	6	0.5	8	0.3
Board of unpaid labor	60	1.9	25	2.2	44	1.8
Total for labor	463	14.3	211	18.0	500	20.9
Livestock expense:						
Concentrated feed for–						
Cattle	144	4.5	72	6.1	220	9.2
Poultry	1,305	40.4	127	10.8	270	11.3
Other livestock	9	0.3	10	0.8	22	0.9
Salt	2	0.1	2	0.2	3	0.1
Feed-grinding	5	0.1	5	0.4	6	0.3
Hay and silage	9	0.3	2	0.2	8	0.3
Pasturage	1	0.0	....	....	2	0.1
Rent of pasture land	....	....	....	....	1	0.1
Bedding	6	0.2	1	0.1	2	0.1
Total feed and bedding	1,481	45.9	219	18.6	534	22.4

(Table 23 is concluded on the following page)

on the poultry farms, $4.73 on the miscellaneous-type farms, and $4.82 on the special farms.

Expenses were high in proportion to the size of business on the farms keeping 400 hens or more, but the additional receipts offset this.

The distribution of expenses was about the same for each type of farm-

TABLE 23 (*concluded*)

	Expenses per farm	Proportion of total expenses	Expenses per farm	Proportion of total expenses	Expenses per farm	Proportion of total expenses
	40 poultry farms		31 miscellaneous-type farms		91 special farms	
Livestock expense (*concluded*):	*Dollars*	*Per cent*	*Dollars*	*Per cent*	*Dollars*	*Per cent*
Other livestock expense:						
Cow-testing	2	0.1	....	....	3	0.1
Registration fees	1	0.0	....	....	2	0.1
Breeding fees	2	0.1	1	0.1	1	0.1
Veterinary fees, medicine, and disinfectants	16	0.5	5	0.4	15	0.6
Horseshoeing	4	0.1	6	0.5	6	0.2
Sheep-shearing	1	0.0	1	0.1	0	0.0
Total other livestock expense	26	0.8	13	1.1	27	1.1
Total for livestock	1,507	46.7	232	19.7	561	23.5
Machinery and equipment:						
Automobile	112	3.5	62	5.3	90	3.8
New machinery	105	3.2	68	5.8	249	10.4
Truck	19	0.6	13	1.2	70	3.0
Tractor	83	2.6	53	4.5	72	3.0
Repairs	31	0.9	16	1.3	24	1.0
Fuel and lubrication	20	0.6	4	0.3	8	0.3
Milk bottles, cans, etc.	8	0.3	0	0.0	14	0.6
Total	378	11.7	216	18.4	527	22.1
Hired machinery:						
Silo-filling	2	0.1	....	....	5	0.2
Baling	17	0.5	15	1.3	3	0.1
Threshing	26	0.8	20	1.7	18	0.7
Milk-hauling	34	1.1	....	....	26	1.1
Other machinery	7	0.2	6	0.5	6	0.3
Total hired machinery	86	2.7	41	3.5	58	2.4
Total for machinery and equipment	464	14.4	257	21.9	585	24.5
Buildings:						
New buildings	93	2.9	5	0.4	153	6.4
Building repairs	134	4.1	108	9.2	127	5.3
Total for buildings	227	7.0	113	9.6	280	11.7
Fences	15	0.5	6	0.6	11	0.5
Fire insurance	33	1.0	28	2.4	27	1.1
Taxes	124	3.8	114	9.7	116	4.8
Crop expense:						
Seeds and plants	78	2.4	54	4.5	72	3.0
Fertilizer	98	3.0	88	7.5	86	3.6
Lime	22	0.7	16	1.4	16	0.7
Spray materials	2	0.1	1	0.1	6	0.3
Total crop expense	200	6.2	159	13.5	180	7.6
Miscellaneous expense:						
Electricity and lighting plant	29	0.9	6	0.5	19	0.8
Telephone	12	0.4	4	0.4	9	0.4
Twine	8	0.2	6	0.5	7	0.3
Ice	1	0.1	....	....	1	0.1
Other miscellaneous expense	147	4.5	37	3.2	91	3.8
Total miscellaneous expense	197	6.1	53	4.6	127	5.4
Total	3,230	100.0	1,173	100.0	2,387	100.0
Cash rent	4		7		18	
Total including cash rent	3,234		1,180		2,405	

ing, except that the poultry farms had a smaller proportion of their expenses for labor and machinery and a higher proportion for feed. Expenses for labor, feed and bedding, and machinery and equipment, made up approximately two-thirds of the total expenses on the farms studied.

FACTORS AFFECTING LABOR INCOME

Probably the most important single factor affecting the labor income of farmers is the general price level, which farmers as individuals have little power to control. Other factors, over which farmers have some control, may be grouped under one of the following classifications: type of farming; size of business; rates of production; diversity of business; labor efficiency; and miscellaneous factors.

Usually, a change in one factor brings about a change in another factor, or occurs independently but at the same time as a change in some other factor. The increase or decrease in returns because of one factor may be larger or smaller than if other factors had remained unchanged. For this reason, it is desirable to know the shifts in factors other than the one considered as the cause.

The analysis which follows deals with the effect of the type of farming, and of other factors within the various types of farming, on the farm labor income.

TYPE OF FARMING

The type of milk market was used as a basis for sorting the farms into type-of-farming groups. Consequently the labor incomes vary from one type of farming to another, because of the difference in the average price received for the milk sold. This was particularly noticeable on farms where dairying made up a major part of the income.

In addition to the differences in the prices received for milk by the different types of farms, the Grade A farms were larger, had better labor efficiency, sold a higher proportion of their milk in the months of October to March, inclusive, had higher production per cow, and had higher crop yields, with a smaller proportion of the total work units on hay and grain, than did either of the other types of dairy farms.

The poultry farms had both high receipts and high expenses in proportion to the number of work units, although the receipts were high enough to more than offset the high expenses.

The miscellaneous-type farms kept their expenses low by hiring cheaper labor and because they did not buy much feed. Prices of crops which they sold and from which they received nearly half of their receipts, were higher in relation to the prices of things which they bought than was the price of Grade B milk, cream, or butter.

The fact that the special group of farms made higher labor incomes than did the other groups was not due to higher receipts from farm products sold or to lower expenses, but was a result of the extra income derived from work off the farm.

Differences in prices received for similar products as between one type of farming and another, and differences in the purchasing power of the different farm products, explain a large proportion of the difference in labor incomes between the different types of farms.

SIZE OF BUSINESS

The following factors are used to measure the size of business: productive-man-work units; number of cows; hundredweight of milk produced; and acres of crops.

Productive-man-work units

In an area where farming is more diversified on some farms than on others, productive-man-work units is probably the best measure of size of business if comparisons are to be made between the different types of farms. It takes into account the amount of work accomplished on all enterprises.

The average number of productive-man-work units on the Grade A farms was 442, as compared with 418 on the Grade B farms and 247 on the other dairy farms (table 8, page 14).

Only 2 Grade A farms had businesses less than 150 productive-man-work units in size. One-fourth, or 25 per cent, of the farms in this group were businesses with 150–299 work units; a little over one-third, or 35 per cent, had 300–449 work units; and 38 per cent had 450 work units or more.

There were only 2 Grade B farms which operated businesses less than 150 productive-man-work units in size. Approximately one-fourth, or 26 per cent, of these farms were businesses with 150–299 work units; 38 per cent had 300–449 work units; and slightly over one-third, or 34 per cent, had 450 work units or more.

The other dairy farms tended to be smaller than either the Grade A or the Grade B farms. Of the 129 farms in this group, 26 per cent were less than 150 productive-man-work units in size; nearly half, or 47 per cent, had 150–299 work units; 15 per cent had 300–449 work units; and 12 per cent had 450 work units or more.

On the Grade A farms, those operating businesses with 150–299 productive-man-work units made labor incomes averaging $312 per farm, as compared with $313 on the farms with 300–449 work units, and $572 on the farms with 450 work units or more (table 24). The labor income increased 64 cents, and the labor returns per man increased 44 cents, with an average increase of 1 work unit on the Grade A farms.

On the Grade B farms, the average labor income for the group that had 150–299 productive-man-work units per farm was –$289, as compared with –$89 on the farms with 300–449 work units, and $252 on the farms with 450 work units or more. The labor income increased $1.40, and the labor returns per man increased $1.18, with an average increase of 1 work unit on the Grade B farms.

The relation of labor income to the size of business as measured by the number of productive-man-work units was very slight on the other dairy farms. Labor returns per man increased, however, as the size of business was increased.

An increase in the size of business appears to have been more advantageous on the Grade B than on the Grade A farms, as shown by the change in labor income or in labor returns per man which accompanied a change in the number of productive-man-work units.

The amount of capital employed in proportion to the number of pro-

TABLE 24. RELATION OF PRODUCTIVE-MAN-WORK UNITS TO LABOR INCOME AND OTHER FACTORS, 378 FARMS, 1937

	Grade A farms*			Grade B farms*			Other dairy farms			
	Productive-man-work units			Productive-man-work units			Productive-man-work units			
	150–299	300–449	450 or more	150–299	300–449	450 or more	Less than 150	150–299	300–449	450 or more
Number of farms	33	46	50	32	46	42	33	61	19	16
Financial returns:										
Farm labor income	$312	$313	$572	–$289	–$89	$252	–$203	–$90	–$180	–$236
Farm labor earnings	$638	$761	$1,063	$87	$366	$735	$168	$312	$343	$358
Percentage return on farm capital	0.0	1.6	3.4	–9.5	–3.2	1.4	–10.8	–5.2	–3.8	–1.1
Labor returns per man	$364	$404	$543	–$50	$162	$408	–$124	$49	$108	$180
Size of business:										
Productive-man-work units	240	377	648	242	363	629	124	210	342	530
Number of cows	8.6	13.2	23.0	7.4	11.5	20.9	2.8	4.2	6.2	6.4
Average farm capital	$6,412	$9,489	$14,330	$5,819	$8,293	$12,290	$4,030	$5,638	$8,968	$12,894
Man equivalent	1.3	1.7	2.5	1.5	1.7	2.3	1.2	1.3	1.6	2.5
Acres of crops	43	67	107	50	76	120	33	55	87	155
Milk sold (hundredweight)	559	790	1,358	424	617	1,249	76	160	222	187
Diversity:										
Per cent of receipts from crops†	6	8	15	6	12	15	19	27	38	48
Per cent of productive-man-work units on hay and grain	18	18	17	23	23	21	29	28	28	34
Per cent of milk sold October–March	48	48	48	45	44	48	....	....	....	....
Acres of crops per animal unit	3.1	3.2	3.1	3.9	3.8	3.7	5.2	5.1	6.1	8.2
Rates of production:										
Milk produced per cow (hundredweight)	73	66	65	64	60	65	55	60	53	55
Value of milk products sold per cow	$155	$143	$132	$113	$106	$116	$34	$48	$39	$47
Crop index (average for region = 100)	107	103	112	94	94	106	87	91	94	88
Labor efficiency:										
Productive-man-work units per man	189	218	260	163	209	272	107	161	207	215
Tons of milk per man	24.6	25.2	30.1	16.0	19.9	29.2	6.8	9.7	10.1	7.1
Acres of crops per man	34	39	43	34	44	52	28	42	53	63
Capital efficiency:										
Capital-receipts ratio†	3.7	3.6	3.5	4.8	4.3	3.4	10.9	5.9	5.6	5.0
Per cent of capital in livestock	19	22	22	19	23	25	14	16	14	12
Capital per man	$5,038	$5,484	$5,746	$3,920	$4,781	$5,322	$3,500	$4,320	$5,444	$5,223
Capital per productive-man-work unit	$27	$25	$22	$24	$23	$20	$33	$27	$26	$24

*There were only 2 Grade A farms and 2 Grade B farms which had less than 150 productive-man-work units. Averages for these farms are not shown here.

†The percentage of receipts from crops, and the capital-receipts ratio (years required for receipts to equal capital), as used in tables 24 to 36, were calculated on the basis of total receipts less the net increase in real estate and equipment.

ductive-man-work units was less with the larger businesses than with the small businesses. This was true for each type of farm. Receipts were larger in proportion to the capital employed on the large farms than on the small farms.

Labor efficiency, capital efficiency, and the percentage of receipts from crops, increased as the size of business increased in each of the three types of farming. A part of the increase in labor income and in labor returns per man may have been due to changes in these factors as well as to changes in the size of business.

The increase in returns to Grade A farmers as the size of business increased took place in spite of the fact that production per cow tended to decrease with increased size, as is indicated by the number of hundredweight of milk produced per cow and also by the value of milk products sold per cow.

The rates of crop production as indicated by the crop index apparently had little relation to the size of business.

Number of cows

The number of cows is a satisfactory measure of size of business on a dairy farm. The more diversified the business, however, the less useful is this factor as a measure of size.

The average number of cows on the Grade A farms was 15.6 per farm, as compared with 13.5 for the Grade B farms and 4.4 for the other dairy farms (table 12, page 17).

Of the Grade A farms, less than one-fifth kept fewer than 10 cows, 40 per cent kept herds of 10–14 cows, and 42 per cent kept herds of 15 cows or more. Grade A farms with less than 10 cows made an average labor income of $109, as compared with $337 on the farms with 10–14 cows, and $599 on the farms with 15 cows or more (table 25). An additional cow on Grade A farms was accompanied by an average increase of $30 in the labor income and $20 in the labor returns per man.

Of the Grade B farms, approximately one-third had herds of less than 10 cows, a little more than one-third, or 37 per cent, had 10–14 cows, and 31 per cent had 15 cows or more. The labor incomes were lower on the Grade B than on the Grade A farms, but showed a similar relationship to the size of herd. The Grade B farms with less than 10 cows made an average labor income of –$242, as compared with –$126 on the farms with 10–14 cows, and $307 on the farms with 15 cows or more. The labor income increased $36, and the labor returns per man increased $27, with an average increase of 1 cow.

Production per cow was lower on the Grade A farms with large herds than on those with small herds, while on the Grade B farms it was about the same regardless of the size of herd. Because of the higher prices received for milk, increased production per cow contributed more to the labor incomes on the Grade A farms than it did on the Grade B farms.

On both the Grade A and the Grade B farms, the number of productive-man-work units per man was higher with large than with small herds, but the increase in labor efficiency was greater on the Grade B farms than on the Grade A farms.

Labor efficiency, intensity of business, and efficiency in the use of capital, improved with increased size of herd on both the Grade A and the Grade B

TABLE 25. RELATION OF NUMBER OF COWS TO LABOR INCOME AND OTHER FACTORS, 375 FARMS, 1937

	Grade A farms			Grade B farms			Other dairy farms*
	Number of cows			Number of cows			Number of cows
	Less than 10	10–14	15 or more	Less than 10	10–14	15 or more	Less than 10
Number of farms	23	53	55	39	45	38	122
Financial returns:							
Farm labor income	$109	$337	$599	–$242	–$126	$307	–$161
Farm labor earnings	$470	$756	$1,074	$164	$330	$769	$274
Percentage return on farm capital	–1.9	1.2	3.8	–7.5	–3.3	1.7	–5.0
Labor returns per man	$230	$413	$556	$13	$149	$427	$46
Size of business:							
Productive-man-work units	229	354	616	254	390	621	243
Number of cows	6.7	12.0	22.9	6.9	11.8	22.3	4.0
Average farm capital	$6,752	$8,796	$13,658	$6,290	$8,818	$11,897	$6,615
Man equivalent	1.3	1.7	2.3	1.6	1.7	2.3	1.5
Acres of crops	50	65	97	56	84	110	67
Milk sold (hundredweight)	433	734	1,352	410	647	1,307	135
Diversity:							
Per cent of receipts from crops†	11.3	9.0	12.7	11.8	13.6	12.1	35.9
Per cent of productive-man-work units on cows	44	50	55	42	45	54	26
Per cent of milk sold October–March	50	48	48	44	46	47	....
Acres of crops per animal unit	4.0	3.4	2.9	4.4	4.1	3.3	6.3
Rates of production:							
Milk produced per cow (hundredweight)	76	68	65	66	61	63	59
Value of milk products sold per cow	$152	$145	$134	$118	$107	$113	$44
Crop index (average for region =100)	104	105	111	97	94	104	90
Labor efficiency:							
Productive-man-work units per man	170	211	264	158	228	269	166
Tons of milk per man	18.7	24.3	31.8	14.4	21.1	30.6	8.1
Acres of crops per man	37	39	41	35	49	48	46
Capital efficiency:							
Capital-receipts ratio†	4.1	3.5	3.5	4.9	4.3	3.4	7.1
Per cent of capital in livestock	17.3	21.2	22.9	18.3	21.2	26.9	13.7
Capital per man	$5,010	$5,232	$5,855	$3,925	$5,140	$5,155	$4,518
Capital per productive-man-work unit	$30	$25	$22	$25	$23	$19	$27

*There were only 7 other dairy farms with 10 or more cows.
†See corresponding footnote to table 24.

farms. Consequently, a part of the increase in labor income and in the labor returns per man was due to these factors rather than to the number of cows.

The other dairy farms practically all had small herds. Of the 129 farms in this group, all but 7, or a total of 95 per cent, had less than 10 cows per farm. Only 1 farm had more than 15 cows.

Hundredweight of milk produced

The total hundredweight of milk produced on a farm is a measure of size of business and rate of milk production combined. The number of cows and the production per cow both affect the total production of milk.

Only 1 Grade A farm produced less than 200 hundredweight of milk during the year, 18 per cent produced 200–599 hundredweight, 40 per cent produced 600–999 hundredweight, and 40 per cent produced 1000 hundredweight or more (table 26). On the Grade A farms, the average increase in the labor income which accompanied an increase in total production of 1 hundredweight of milk was 73 cents, and the average increase in the labor returns per man was 43 cents. The return on capital increased from –4.2 per cent on the farms producing the smallest amount of milk, to 5.2 per cent on the farms producing the most milk (table 26).

There were no Grade B farms that produced less than 200 hundredweight of milk during the year. The proportions of the Grade B farms falling in the three groups according to total production, were, respectively, 39 per cent, 34 per cent, and 27 per cent. On the Grade B farms, an average increase in output of 1 hundredweight of milk was accompanied by an increase of 64 cents in the labor income and 44 cents in the labor returns per man. The return on capital was –8.4 per cent on the group that had the smallest production of milk per farm, and 2.2 per cent on the farms with the largest production.

Nearly half, or 47 per cent, of the other dairy farms produced less than 200 hundredweight of milk during the year, 49 per cent produced 200–599 hundredweight, and only 4 per cent produced more than 599 hundredweight. On the other dairy farms, both the labor returns per man and the percentage return on capital were higher with the higher total production of milk.

Labor efficiency, rates of crop production, production per cow, and efficiency in the use of capital, all improved as the milk production increased in number of hundredweight. A part of the increase in the labor returns per man was due to these changes as well as to the additional milk produced.

The farms that produced the most milk had a higher proportion of their productive-man-work units on cows, and had larger businesses in proportion to the number of acres of crops, than did the farms producing less milk. About the same proportion of the receipts were derived from the sale of crops regardless of the quantity of milk produced, except on the other dairy farms, where the receipts from crops became much less important as the amount of milk produced increased.

Acres of crops

In an area where dairying is the most important part of the farming operations, acres of crops is not a good measure of size of business. It

TABLE 26. Relation of Hundredweight of Milk Produced to Labor Income and Other Factors, 376 Farms, 1937

	Grade A farms*			Grade B farms*			Other dairy farms*	
	Milk produced (hundredweight)			Milk produced (hundredweight)			Milk produced (hundredweight)	
	200–599	600–999	1000 or more	200–599	600–999	1000 or more	Less than 200	200–599
Number of farms	24	53	53	47	42	33	61	63
Financial returns:								
Farm labor income	–$3	$230	$785	–$338	–$1	$378	–$155	–$158
Farm labor earnings	$378	$665	$1,238	$68	$446	$864	$267	$285
Percentage return on farm capital	–4.2	0.2	5.2	–8.4	–1.8	2.2	–6.5	–3.8
Labor returns per man	$160	$353	$625	–$25	$201	$466	0	$80
Size of business:								
Productive-man-work units	266	377	593	280	397	643	201	279
Number of cows	7.8	13.1	21.9	8.2	12.5	22.5	2.5	5.8
Average farm capital	$6,850	$9,242	$13,491	$6,664	$8,571	$12,758	$5,659	$7,400
Man equivalent	1.4	1.7	2.4	1.6	1.7	2.4	1.3	1.6
Acres of crops	51	69	94	59	83	118	62	68
Milk sold (hundredweight)	424	711	1,418	389	682	1,450	40	222
Diversity:								
Per cent of receipts from crops†	11.2	7.9	13.3	10.6	12.6	13.4	43.2	28.7
Per cent of productive-man-work units on hay and grain	20	19	16	23	24	20	35	26
Per cent of milk sold October–March	47	47	50	42	48	49	....	....
Acres of crops per animal unit	3.7	3.3	2.9	4.0	4.0	3.4	7.8	5.0
Rates of production:								
Milk produced per cow (hundredweight)	61	61	71	54	60	69	48	58
Value of milk products sold per cow	$129	$129	$146	$94	$107	$124	$21	$49
Crop index (average for region = 100)	103	100	117	94	94	111	90	89
Labor efficiency:								
Productive-man-work units per man	185	227	252	175	230	267	150	179
Tons of milk per man	16.7	23.9	33.1	14.0	21.8	32.4	4.6	10.9
Acres of crops per man	36	42	40	37	48	49	46	44
Capital efficiency:								
Capital-receipts ratio†	4.0	3.9	3.1	5.2	3.9	3.1	8.5	5.8
Per cent of capital in livestock	18	21	23	20	22	26	12	15
Capital per productive-man-work unit	$26	$25	$23	$24	$22	$20	$28	$27

*Only 1 Grade A farm and no Grade B farm produced less than 200 hundredweight of milk, and only 5 other dairy farms produced more than 599 hundredweight of milk.

†See corresponding footnote to table 24.

does not necessarily determine the carrying capacity of a dairy farm. On farms where crop farming is more important, as in the townships of Ulysses and Lansing, acres of crops is more satisfactory as a measure of size of business.

Of the Grade A farms, 27 per cent had less than 50 acres of crops, 43 per cent had 50–89 acres, and 30 per cent had 90 acres or more. Labor incomes increased from $309 on the Grade A farms that had the smallest acreage of crops, to $518 on the farms that had the largest acreage of crops (table 27). An increase of 1 acre of crops was accompanied by an average increase of $2.46 in the labor income and $1.87 in the labor returns per man. Return on capital increased from 0.4 per cent on the farms with the smallest crop acreage, to 3.2 per cent on the farms with the largest crop acreage.

Of the Grade B farms, 22 per cent had less than 50 acres of crops, 43 per cent had 50–89 acres, and 35 per cent had 90 acres or more. On the Grade B farms, labor incomes increased from –$195 on the farms with less than 50 acres of crops, to $172 on the farms with 90 acres or more. An increase of 1 acre of crops was accompanied by an average increase of $4.37 in the labor income and $4.60 in the labor returns per man. Return on capital increased from –7.0 per cent in the lowest crop-acreage group, to 0.9 per cent in the highest.

On the other dairy farms, 45 per cent of the farms had less than 50 acres of crops, 35 per cent had 50–89 acres, and 20 per cent had 90 acres or more. There was little relationship between the labor income and the acres of crops on the other dairy farms. The farms that had 50–89 acres of crops made an average labor income of –$42, as compared with –$144 on the farms with less than 50 acres of crops. But the average labor income on the farms that had 90 acres of crops or more was –$350. A large proportion of the income on other dairy farms was derived from the sale of crops. Many of these farms grew wheat, buckwheat, and hay crops, with a low value per acre.

On both the Grade A and the Grade B farms, the number of cows increased as the number of acres of crops increased, but less rapidly. The percentage of the total receipts from crops was larger, and the labor efficiency was better, on the farms with the larger crop acreages than on those with the smaller crop acreages. Capital efficiency was slightly better on the farms with the larger crop acreages.

One reason why the labor returns showed a greater response to an increase in the acres of crops on the Grade B farms, was that production per cow and labor efficiency increased along with the increase in crop acreage on the Grade B farms more than they did on the Grade A farms. The increase in the labor incomes of the Grade A farms took place in spite of lower production per cow.

RATES OF PRODUCTION

Crop yields and production per cow are both dependent on capacity of the soil and of the cow to produce, and on the operator's management. The higher the crop yield or the production per cow, the more income there is to be derived from a single acre or a single cow. The additional costs involved do not equal the additional income derived from the extra production on farms with better-than-average rates of production.

TABLE 27. RELATION OF ACRES OF CROPS TO LABOR INCOME AND OTHER FACTORS, 382 FARMS, 1937

	Grade A farms			Grade B farms			Other dairy farms		
	Acres of crops			Acres of crops			Acres of crops		
	Less than 50	50–89	90 or more	Less than 50	50–89	90 or more	Less than 50	50–89	90 or more
Number of farms	35	56	40	27	52	43	58	45	26
Financial returns:									
Farm labor income	$309	$389	$518	−$195	−$107	$172	−$144	−$42	−$350
Farm labor earnings	$671	$811	$1,026	$172	$316	$682	$235	$387	$220
Percentage return on farm capital	0.4	2.0	3.2	−7.0	−4.3	0.9	−8.6	−3.6	−2.7
Labor returns per man	$368	$445	$527	−$15	$150	$371	−$33	$120	$81
Size of business:									
Productive-man-work units	271	395	659	246	368	587	161	256	422
Number of cows	10.3	14.3	22.3	8.3	12.6	18.0	3.8	5.0	4.8
Average farm capital	$6,840	$9,371	$15,212	$5,652	$7,865	$12,386	$4,386	$6,540	$11,727
Man equivalent	1.4	1.7	2.6	1.4	1.7	2.3	1.2	1.4	2.1
Acres of crops	37	67	122	41	71	125	34	63	142
Milk sold (hundredweight)	632	873	1,304	427	687	1,105	137	178	137
Diversity:									
Per cent of receipts from crops†	5	8	17	4	6	18	13	34	49
Per cent of productive-man-work units on hay and grain	13	17	19	17	21	24	23	26	40
Acres of crops per animal unit	2.3	3.0	3.6	3.0	3.4	4.3	3.9	5.5	9.3
Rates of production:									
Milk produced per cow (hundredweight)	69	68	65	58	60	67	59	58	53
Value of milk products sold per cow	$145	$142	$133	$102	$106	$120	$49	$41	$39
Crop index (average for region = 100)	110	106	107	98	91	107	90	90	89
Labor efficiency:									
Productive-man-work units per man	197	226	257	176	213	254	133	181	202
Tons of milk per man	25.6	27.8	28.1	17.0	22.0	26.0	9.3	10.2	6.1
Acres of crops per man	27	38	48	29	41	54	28	45	68
Capital efficiency:									
Capital-receipts ratio†	3.4	3.6	3.7	5.2	4.2	3.6	8.2	6.3	5.6
Per cent of capital in livestock	22	21	22	20	24	23	16	16	11
Capital per productive-man-work unit	$25	$24	$23	$23	$21	$21	$27	$26	$28

†See corresponding footnote to table 24 (page 33).

Crop index

Of the Grade A farms, 16 per cent had crop yields which were less than 80 per cent as good as the average for the entire region, 26 per cent had crop yields which were 80–99 per cent of the average, 31 per cent had yields which were 100–119 per cent of the average, and 27 per cent had yields which were 120 per cent or more of the average. The average labor incomes on the Grade A farms were $65, $90, $564, and $731 per farm, respectively, for the four groups of farms, from those with the lowest to those with the highest crop indexes (table 28). The percentage return on the capital was also highest on the farms in the group with the highest crop yields. The labor income increased $94, and the labor returns per man increased $57, with an average increase of 10 per cent in the crop index.

Of the Grade B farms, 18 per cent were in the first group, with the lowest crop yields, 39 per cent were in the second group, 27 per cent were in the third group, and 16 per cent were in the group with the highest yields. The average labor income per farm was –$227 on the Grade B farms with the lowest crop yields, –$148 in the second group, $72 in the third group, and $307 in the group with the highest crop yields. The percentage return on the capital increased from –5.6 on the farms with the lowest yields, to 1.5 per cent on the farms with the highest yields. The labor income increased $76, and the labor returns per man increased $49, with an average increase of 10 per cent in the crop index.

Of the other dairy farms, 35 per cent were in the group with the lowest crop yields, 29 per cent were in the second group, 27 per cent were in the third group, and only 9 per cent had yields as high as 120 per cent or more of the average for the area studied. The average labor incomes on the other dairy farms were, respectively, –$262, –$111, –$167, and $200 per farm, for the four groups of farms, from those with the lowest to those with the highest crop yields. The percentage return on the capital increased from –8.0 per cent on the farms with the lowest crop yields, to 1.2 per cent on the farms with the highest crop yields. With an average increase of 10 per cent in the crop index, the labor income increased $63 and the labor returns per man increased $56. The more intensive the system of farming, the more did the labor income increase for a given increase in crop yields. The increase in labor returns per man were much the same regardless of intensiveness of the farming system.

The size of business increased as the average crop index increased. Production per cow, as measured by the hundredweight of milk produced or by the value of milk products sold per cow, increased with the crop index on both the Grade A and the Grade B farms. The capital employed per man-work unit and the number of productive-man-work units increased in relation to the acres of crops, as the crop index increased. Even though the capital employed increased in proportion to the work units, the number of years required for the receipts to equal the capital decreased except in the case of the Grade A farms. Apparently there was little relation of the labor efficiency and the proportion of the total work units on cows, to the crop index. Farms with good yields were the better, larger, more intensive dairy farms of the area.

TABLE 28. RELATION OF CROP YIELDS TO LABOR INCOME AND OTHER FACTORS, 382 FARMS, 1937

	Grade A farms				Grade B farms				Other dairy farms			
	Crop index				Crop index				Crop index			
	Less than 80	80–99	100–119	120 or more	Less than 80	80–99	100–119	120 or more	Less than 80	80–99	100–119	120 or more
Number of farms	21	34	40	36	22	47	33	20	45	37	35	12
Financial returns:												
Farm labor income	$65	$90	$564	$731	–$227	–$148	$72	$307	–$262	–$111	–$167	$200
Farm labor earnings	$452	$523	$1,013	$1,171	$184	$279	$556	$745	$113	$340	$295	$736
Percentage return on farm capital	–3.6	–0.5	3.9	4.9	–5.6	–3.8	–0.9	1.5	–8.0	–3.3	–5.2	1.2
Labor returns per man	$230	$315	$536	$638	$73	$127	$284	$418	–$84	$86	$77	$328
Size of business:												
Productive-man-work units	399	467	410	480	375	368	459	518	225	276	247	240
Number of cows	13.4	16.5	14.8	17.1	13.1	11.3	14.8	17.4	4.2	4.6	4.7	3.9
Average farm capital	$7,619	$10,156	$10,540	$12,383	$7,545	$8,202	$9,891	$10,815	$5,727	$7,392	$6,763	$7,142
Man equivalent	1.6	2.0	1.8	2.0	1.6	1.8	2.0	2.1	1.3	1.5	1.6	1.4
Acres of crops	82	83	67	75	72	82	89	90	64	75	64	58
Milk sold (hundredweight)	749	909	927	1,095	610	624	903	1,111	148	178	139	118
Diversity:												
Per cent of receipts from crops†	8	9	7	18	5	11	15	15	33	35	27	50
Per cent of productive-man-work units on hay and grain	21	19	16	15	21	25	22	18	32	30	29	24
Per cent of milk sold October–March	48	47	48	50	40	44	50	49	....	....	....	....
Acres of crops per animal unit	3.9	3.3	2.9	2.9	3.5	4.2	3.8	3.2	7.1	6.1	5.0	5.5
Rates of production:												
Milk produced per cow (hundredweight)	62	60	71	71	53	62	66	69	55	63	54	54
Value of milk products sold per cow	$127	$128	$147	$146	$94	$109	$118	$123	$52	$43	$37	$38
Crop index (average for region =100)	72	90	108	143	66	90	109	136	63	89	109	136
Labor efficiency:												
Productive-man-work units per man	252	231	222	238	231	210	225	246	169	182	156	167
Tons of milk per man	26.2	24.6	28.3	30.0	21.4	19.7	24.0	28.7	8.6	9.6	8.1	7.4
Acres of crops per man	52	41	36	37	44	46	44	43	48	49	40	40
Capital efficiency												
Capital-receipts ratio†	3.4	3.7	3.5	3.7	5.0	4.4	3.9	3.5	9.5	5.8	5.7	5.2
Per cent of capital in livestock	24	21	22	21	23	21	23	26	13	14	16	13
Capital per man	$4,819	$5,026	$5,713	$6,132	$4,663	$4,678	$4,843	$5,150	$4,302	$4,884	$4,280	$4,983
Capital per productive-man-work unit	$19	$22	$26	$26	$20	$22	$22	$21	$25	$27	$27	$30

†See corresponding footnote to table 24 (page 33).

Hundredweight of milk produced per cow

A change in the production per cow is more important on Grade A farms than it is on either of the other types of farms in this study, because of the higher price received for each hundredweight of milk sold.

Of the Grade A farms, one-fourth, or 25 per cent, had cows that produced less than 60 hundredweight of milk per cow, 31 per cent had cows that produced 60–69 hundredweight per cow, and 44 per cent had cows that produced 70 hundredweight or more per cow. The average labor incomes on the three groups of Grade A farms were –$182, $365, and $761, respectively (table 29). The return on capital increased from –5.3 per cent on the farms with the lowest-producing cows, to 5.7 per cent on the farms with the highest-producing cows. The labor income increased $29, the labor earnings increased $29, and the labor returns per man increased $16, for an average increase of 1 hundredweight of milk produced per cow.

Of the Grade B farms, 39 per cent had cows that produced less than 60 hundredweight of milk per cow, 28 per cent had cows that produced 60–69 hundredweight per cow, and one-third, or 33 per cent, had cows that produced 70 hundredweight or more per cow. The average labor incomes on the three groups of Grade B farms were –$271, –$64, and $294, respectively. The return on capital increased from –5.5 per cent on the farms with the lowest-producing cows, to 1.2 per cent on the farms with the highest-producing cows. The labor income increased $18, the labor earnings increased $20, and the labor returns per man increased $11, for an average increase of 1 hundredweight of milk produced per cow.

Of the other dairy farms, over half, or 52 per cent, had cows that produced less than 60 hundredweight of milk per cow, 12 per cent had cows that produced 60–69 hundredweight per cow, and 36 per cent had cows that produced 70 hundredweight or more per cow. The labor income on the other dairy farms did not show as close a relationship to the production per cow as it did on the Grade A and Grade B farms. This might be expected, because of the fact that a small proportion of the total receipts were derived from the sale of milk and because of the low price received for milk sold.

The proportion of the total receipts derived from the sale of crops increased as the production per cow increased, on the Grade A and Grade B farms. Total receipts increased in relation to the capital employed, on all types of farms. Labor efficiency as measured by productive-man-work units per man showed little relation to production per cow; but in terms of tons of milk produced per man, the labor efficiency improved as the production per cow increased. Farms with cows that produced 60–69 hundredweight of milk were the most profitable.

DIVERSITY OF BUSINESS

Several measures of diversification of the business have been used in this study, including the percentage of the receipts from crops, the percentage of the total productive-man-work units on hay and grain, the percentage of the capital in cows, and the percentage of milk sold from October through March.

TABLE 29. RELATION OF MILK PRODUCED PER COW TO LABOR INCOME AND OTHER FACTORS, 382 FARMS, 1937

	Grade A farms			Grade B farms			Other dairy farms		
	Milk produced per cow (hundredweight)			Milk produced per cow (hundredweight)			Milk produced per cow (hundredweight)		
	Less than 60	60–69	70 or more	Less than 60	60–69	70 or more	Less than 60	60–69	70 or more
Number of farms	32	41	58	48	34	40	67	16	46
Financial returns:									
Farm labor income	–$182	$365	$761	–$271	–$64	$294	–$188	–$45	–$132
Farm labor earnings	$256	$802	$1,187	$136	$394	$763	$195	$489	$345
Percentage return on farm capital	–5.3	2.4	5.7	–5.5	–2.4	1.2	–6.1	–1.9	–4.4
Labor returns per man	$125	$449	$649	$55	$239	$383	$21	$110	$71
Size of business:									
Productive-man-work units	407	506	416	371	489	415	238	308	239
Number of cows	14.5	18.3	14.4	12.6	16.8	12.0	4.7	4.8	3.9
Average farm capital	$8,912	$11,907	$10,333	$7,756	$9,688	$9,812	$5,922	$9,044	$6,785
Man equivalent	1.7	2.2	1.8	1.7	2.1	1.8	1.4	1.7	1.4
Acres of crops	69	86	72	71	97	86	62	81	68
Milk sold (hundredweight)	615	1,082	1,020	531	1,029	857	112	161	204
Diversity:									
Per cent of receipts from crops†	8.8	11.0	12.5	8.7	14.7	13.4	36.8	30.8	31.8
Per cent of productive-man-work units on cows	53	54	52	51	52	44	32	23	23
Per cent of milk sold October–March	46	50	49	41	48	50	....	....	....
Acres of crops per animal unit	3.1	3.1	3.1	3.5	3.9	4.0	5.9	5.4	6.4
Rates of production:									
Milk produced per cow (hundredweight)	47	64	79	48	66	79	43	64	79
Value of milk products sold per cow	$99	$137	$162	$85	$118	$140	$33	$43	$62
Crop index (average for region =100)	98	106	113	88	109	102	88	92	92
Labor efficiency:									
Productive-man-work units per man	242	234	229	217	231	227	168	179	166
Tons of milk per man	20.4	27.2	31.4	17.6	26.0	25.8	7.1	8.9	10.7
Acres of crops per man	41	40	40	42	46	47	44	47	47
Capital efficiency:									
Capital-receipts ratio†	4.4	3.6	3.1	5.1	3.7	3.6	8.0	6.7	5.7
Per cent of capital in livestock	22.1	22.8	20.6	22.2	24.0	22.6	14.8	14.1	13.5
Capital per man	$5,291	$5,492	$5,675	$4,534	$4,575	$5,355	$4,199	$5,243	$4,707
Capital per productive-man-work unit	$22	$24	$25	$21	$20	$24	$25	$29	$28

†See corresponding footnote to table 24 (page 33).

Percentage of receipts from crops

Of the Grade A farms, 40 per cent derived less than 5 per cent of their total receipts from crop sales, 40 per cent derived 5–14 per cent of their total receipts from crop sales, and 20 per cent derived 15 per cent or more of their total receipts from crop sales. The labor income increased as the percentage of the receipts from crops increased for all three types of farms —Grade A, Grade B, and other dairy(table 30).

On the Grade A farms, the average labor incomes for the three groups of farms were $298, $407, and $629, respectively. Return on the capital increased from 1.2 per cent to 3.6 per cent as the percentage of receipts from crops increased. The average increase in the labor income was $13, the increase in the labor earnings was $14, and the increase in the labor returns per man was $8, for an average increase of 1 per cent in the receipts from the sale of crops.

Of the Grade B farms, 37 per cent derived less than 5 per cent of their total receipts from crop sales, 37 per cent derived 5–14 per cent of their total receipts from crop sales, and 26 per cent derived 15 per cent or more of their total receipts from crop sales. The average labor incomes for the three groups of farms were –$73, –$84, and $115, respectively. Return on the capital increased from –3.6 per cent to –0.1 per cent as the percentage of receipts from crops increased. The labor income increased $7, the labor earnings $11, and the labor returns per man $7, for an average increase of 1 per cent in the receipts from the sale of crops.

Of the other dairy farms, 22 per cent received less than 5 per cent of their total receipts from crop sales, 21 per cent received 5–14 per cent of their total receipts from crop sales, and over half, or 57 per cent, received 15 per cent or more of their total receipts from crop sales. The average labor incomes for the three groups of farms were –$173, –$159, and –$138, respectively. Return on the capital increased from –7.1 per cent to 3.6 per cent as the percentage of receipts from crops increased. The labor income increased $1, the labor earnings $2, and the labor returns per man $3, for an average increase of 1 per cent in the receipts from the sale of crops.

The farms that received a larger proportion of their receipts from the sale of crops operated larger businesses, and obtained higher yields, than did the farms that had a smaller proportion of their receipts from crops. Although the farms in the former group had higher yields, the intensity of stocking, and consequently the amount of manure available per acre of crops, was less.

The relation of labor efficiency to the percentage of the receipts from crops depends on the measure of labor efficiency used. The number of productive-man-work units per man did not show much relationship to this factor. Since the proportion of work units on cows also decreased, tons of milk per man decreased, as the percentage of receipts from crops increased. Acres of crops per man was larger on the farms that derived a larger proportion of their receipts from the sale of crops.

Percentage of productive-man-work units on hay and grain

Of the Grade A farms, 37 per cent had less than 15 per cent of their work units on hay and grain, 48 per cent had 15–24 per cent of their work units

TABLE 30. RELATION OF PERCENTAGE OF RECEIPTS FROM CROPS TO LABOR INCOME AND OTHER FACTORS, 382 FARMS, 1937

	Grade A farms			Grade B farms			Other dairy farms		
	Per cent of receipts from crops			Per cent of receipts from crops			Per cent of receipts from crops		
	Less than 5	5–14	15 or more	Less than 5	5–14	15 or more	Less than 5	5–14	15 or more
Number of farms	53	52	26	45	45	32	28	27	74
Financial returns:									
Farm labor income	$298	$407	$629	–$73	–$84	$115	–$173	–$159	–$138
Farm labor earnings	$714	$850	$1,075	$345	$336	$618	$208	$271	$320
Percentage return on farm capital	1.2	2.3	3.6	–3.6	–2.7	–0.1	–7.1	–6.8	3.6
Labor returns per man	$387	$453	$597	$151	$197	$319	–$26	–$5	$94
Size of business:									
Productive-man-work units	377	456	549	354	450	464	200	206	279
Number of cows	14.7	15.7	17.4	12.8	14.7	13.1	5.9	4.4	3.9
Average farm capital	$9,458	$9,867	$13,781	$7,653	$9,256	$10,416	$5,271	$5,574	$7,507
Man equivalent	1.7	1.8	2.4	1.6	2.0	2.1	1.3	1.3	1.6
Acres of crops	58	80	103	62	89	105	39	49	83
Milk sold (hundredweight)	891	925	1,071	713	830	793	207	176	121
Diversity:									
Per cent of receipts from crops†	1.6	8.6	27.9	1.6	8.8	27.1	0.8	9.4	47.9
Per cent of productive-man-work units on cows	58	51	47	54	49	42	43	33	22
Per cent of productive-man-work units on hay and grain	15	18	18	19	22	26	20	25	34
Per cent of milk sold October–March	50	48	47	45	48	44	....	....	....
Acres of crops per animal unit	2.5	3.3	3.9	3.0	3.7	4.9	3.4	4.3	7.7
Rates of production:									
Milk produced per cow (hundredweight)	67	64	71	61	62	67	54	60	57
Value of milk products sold per cow	$142	$136	$137	$108	$111	$120	$47	$46	$41
Crop index (average for region =100)	101	106	123	94	98	106	87	93	90
Labor efficiency:									
Productive-man-work units per man	218	248	233	225	229	218	150	158	178
Tons of milk per man	28.5	27.4	26.0	24.8	23.2	20.5	12.1	10.3	7.1
Acres of crops per man	34	44	44	39	45	50	29	38	53
Capital efficiency:									
Capital-receipts ratio†	3.7	3.5	3.5	4.4	4.2	3.9	8.8	7.6	6.1
Per cent of capital in livestock	23	23	19	24	24	21	18	18	12
Capital per productive-man-work unit	$25	$22	$25	$22	$21	$22	$26	$27	$27

†See corresponding footnote to table 24 (page 33).

on hay and grain, and 15 per cent had 25 per cent or more of their total work units on hay and grain. The labor income on the Grade A farms decreased $31, and the labor returns per man decreased $15, with an average increase of 1 per cent in the work units on hay and grain. The return on capital decreased from 4.2 per cent in the group which had the smallest proportion of work units on hay and grain, to 0.1 per cent in the group with the largest proportion of work units on hay and grain (table 31).

Of the Grade B farms, 16 per cent had less than 15 per cent of their work units on hay and grain, 50 per cent had 15–24 per cent of their work units on hay and grain, and 34 per cent had 25 per cent or more of their work units on hay and grain. The labor income on the Grade B farms decreased $24, and the labor returns per man decreased $13, with an average increase of 1 per cent in the work units on hay and grain. The return on capital decreased from 1.7 per cent on the farms with the smallest proportion of work units on hay and grain, to –2.5 per cent on the farms with the largest proportion of work units on hay and grain.

Of the other dairy farms, 11 per cent had less than 15 per cent of their work units on hay and grain, 32 per cent had 15–24 per cent of their work units on hay and grain, and 57 per cent had 25 per cent or more of their work units on hay and grain. The labor income on the other dairy farms decreased $11, and the labor returns per man decreased $7, with an average increase of 1 per cent in the work units on hay and grain. The return on capital decreased from –3.5 per cent for the group with the smallest proportion of work units on hay and grain, to –4.8 per cent for the group which had the largest proportion of work units on hay and grain.

On each type of farm, the labor income decreased as the proportion of work units on hay and grain increased. The labor incomes were $650, $312, and $123, respectively, on the Grade A farms. On the Grade B farms they declined from $291 in the group with the smallest proportion of work units on hay and grain, to –$136 in the group with the largest proportion of work units on hay and grain. On the other dairy farms they were $106, –$141, and –$204, respectively. Under conditions prevailing in 1937, it did not pay so well to operate an extensive hay and grain farm with relatively small numbers of livestock, as it did to operate an intensive dairy farm.

Acres of crops operated increased as the proportion of work units on hay and grain increased. Offsetting this in size of business was the fact that the number of cows decreased.

The amount of milk produced per man decreased on each type of farm, but acres of crops per man increased, with an increase in the proportion of work units on hay and grain. On the Grade A farms the decrease in the amount of milk handled per man, as indicated by the tons of milk per man, was more than offset by the increase in work done per man on other things, such as crops. This was not true for the Grade B farms and the other dairy farms.

On all three types of farms, the length of time required for the 1937 receipts to equal the average amount of capital employed, increased as the proportion of the work on hay and grain increased.

Production per cow had little relation to the percentage of work units on hay and grain, but the crop index on the Grade A and Grade B farms was highest where a small proportion of the work units was on hay and grain.

TABLE 31. RELATION OF PERCENTAGE OF PRODUCTIVE-MAN-WORK UNITS ON HAY AND GRAIN TO LABOR INCOME AND OTHER FACTORS, 382 FARMS, 1937

	Grade A farms			Grade B farms			Other dairy farms		
	Per cent of productive-man-work units on hay and grain								
	Less than 15	15–24	25 or more	Less than 15	15–24	25 or more	Less than 15	15–24	25 or more
Number of farms	48	63	20	19	61	42	14	41	74
Financial returns:									
Farm labor income	$650	$312	$123	$291	−$53	−$136	$106	−$141	−$204
Farm labor earnings	$1,067	$738	$612	$676	$383	$339	$486	$297	$241
Percentage return on farm capital	4.2	1.3	0.1	1.7	−3.4	−2.5	−3.5	−5.2	−4.8
Labor returns per man	$584	$398	$332	$417	$179	$186	$245	$20	$32
Size of business:									
Productive-man-work units	489	416	412	527	375	433	270	237	248
Number of cows	18.3	14.7	12.2	20.1	12.6	12.0	5.8	5.6	3.5
Average farm capital	$11,373	$9,571	$11,190	$10,258	$7,890	$9,952	$5,764	$5,736	$7,266
Man equivalent	2.0	1.8	2.0	1.9	1.8	2.0	1.4	1.3	1.5
Acres of crops	65	75	102	71	70	108	36	48	82
Milk sold (hundredweight)	1,129	851	771	1,188	692	715	243	210	101
Diversity:									
Per cent of receipts from crops†	14	8	15	9	10	17	29	20	42
Per cent of productive-man-work units on cows	56	53	47	57	50	42	39	36	21
Per cent of productive-man-work units on hay and grain	12	19	29	12	20	30	10	20	39
Productive-man-work units per acre of crops	7.5	5.5	4.0	7.4	5.3	4.0	7.4	4.9	3.0
Rates of production:									
Milk produced per cow (hundredweight)	68	65	70	64	60	66	59	55	58
Value of milk products sold per cow	$140	$136	$145	$115	$106	$119	$70	$44	$35
Crop index (average for region = 100)	121	99	100	114	96	95	85	95	88
Labor efficiency:									
Productive-man-work units per man	242	235	207	279	213	216	187	178	161
Tons of milk per man	30.7	26.9	21.3	34.1	21.6	19.8	11.8	11.6	6.7
Acres of crops per man	32	43	52	37	40	54	25	36	53
Capital efficiency:									
Capital-receipts ratio†	3.3	3.7	4.1	3.7	4.3	4.4	4.2	6.6	7.7
Per cent of capital in livestock	23	21	19	30	23	20	17	18	12
Capital per productive-man-work unit	$23	$23	$27	$19	$21	$23	$21	$24	$29

†See corresponding footnote to table 24 (page 33).

Capital in cows at end of year as a percentage of total capital

Large herds with good cows have a larger proportion of the total capital in cows than do small herds with poor cows.

Of the Grade A farms, 15 per cent had less than 10 per cent of the total capital in cows at the end of the year, 38 per cent had 10–14 per cent of the capital in cows, and 47 per cent had 15 per cent or more of the capital in cows.

On the Grade B farms, 24 per cent had less than 10 per cent of the total capital in cows at the end of the year, 39 per cent had 10–14 per cent of the capital in cows, and 37 per cent had 15 per cent or more of the capital in cows.

On the other dairy farms, 85 per cent had less than 10 per cent of the capital in cows, 12 per cent had 10–14 per cent of the capital in cows, and 3 per cent had 15 per cent or more of the capital in cows.

The labor income increased as the percentage of capital in cows increased. On the Grade A farms the labor incomes were –$124, $495, and $508 in the three groups, respectively (table 32). On the Grade B farms the labor incomes were –$312, –$101, and $233. On the other dairy farms the labor incomes were –$169, –$58, and $22.

As the percentage of capital in cows increased, the size of business also increased. This increase in size of business was mostly because of the increased number of cows kept. The acres of crops had little relation to the percentage of capital in cows.

The number of productive-man-work units per man, and the tons of milk per man, increased as the proportion of capital in cows increased. Likewise, the farms with a larger proportion of capital in cows used capital more efficiently than did the farms with a smaller proportion of the capital in cows.

The increase in labor incomes must have been due largely to the fact that the farms having a larger proportion of their capital in cows also operated larger businesses, had better labor efficiency and better capital efficiency, and were engaged in an enterprise that was more profitable than were other more extensive types of farming.

Percentage of milk sold from October through March

The prices received in the months of October to March inclusive are the highest prices received for milk during the year.

Of the Grade A farms, 31 per cent sold less than 45 per cent of their milk during the months of October to March inclusive, 37 per cent sold 45–50 per cent of their milk during those months, and 32 per cent sold more than 50 per cent of their milk during those months. The average labor incomes on the Grade A farms were $132, $522, and $479, for the respective groups (table 33). With an average increase of 1 per cent in quantity sales from October through March, the labor income increased $18 and the labor returns per man increased $11. The return on capital increased from –0.5 per cent in the group selling the smallest proportion of milk during the winter months, to 3.1 per cent in the group selling the largest proportion.

Of the Grade B farms, 49 per cent sold less than 45 per cent of their milk during the months of October to March inclusive, 21 per cent sold 45–50 per cent of their milk during those months, and 30 per cent sold more than

TABLE 32. RELATION OF PERCENTAGE OF CAPITAL IN COWS TO LABOR INCOME AND OTHER FACTORS, 382 FARMS, 1937

	Grade A farms			Grade B farms			Other dairy farms		
	Per cent of capital in cows			Per cent of capital in cows			Per cent of capital in cows		
	Less than 10	10–14	15 or more	Less than 10	10–14	15 or more	Less than 10	10–14	15 or more
Number of farms	20	50	61	29	48	45	110	15	4
Financial returns:									
Farm labor income	–$124	$495	$508	–$312	–$101	$233	–$169	–$58	$22
Farm labor earnings	$380	$934	$913	$148	$344	$659	$282	$265	$447
Percentage return on farm capital	–2.6	3.3	3.0	–4.1	–3.6	0.5	–4.5	–9.7	–2.0
Labor returns per man	$197	$509	$514	$40	$186	$336	$47	$70	$126
Size of business:									
Productive-man-work units	338	459	463	334	378	516	247	220	338
Number of cows	10.0	15.8	17.4	8.8	11.6	18.7	4.0	5.9	11.8
Average farm capital	$11,190	$11,788	$9,172	$9,834	$8,246	$9,182	$7,021	$3,820	$6,000
Man equivalent	1.9	1.9	1.9	1.8	1.9	1.9	1.5	1.3	1.4
Acres of crops	76	81	71	82	78	90	70	44	52
Milk sold (hundredweight)	577	962	1,041	544	656	1,056	133	201	476
Diversity:									
Per cent of receipts from crops†	11	14	9	16	14	10	37	14	0
Per cent of productive-man-work units on cows	45	51	56	39	46	54	25	42	52
Per cent of productive-man-work units on hay and grain	26	18	15	28	24	18	32	21	2
Rates of production:									
Milk produced per cow (hundredweight)	64	68	66	70	63	61	58	53	56
Value of milk products sold per cow	$136	$141	$138	$124	$111	$109	$42	$46	$51
Crop index (average for region = 100)	104	106	109	100	96	100	91	77	108
Labor efficiency:									
Productive-man-work units per man	181	239	245	189	201	270	166	171	241
Tons of milk per man	17.3	28.0	30.4	17.4	19.4	29.9	7.8	12.0	23.6
Acres of crops per man	41	42	38	46	42	47	47	34	37
Capital efficiency:									
Capital-receipts ratio†	5.1	3.8	2.9	5.6	4.2	3.3	7.3	5.5	4.6
Per cent of capital in livestock	14	19	27	16	21	30	13	22	30
Capital per productive-man-work unit	$58	$50	$36	$51	$39	$34	$42	$22	$26

†See corresponding footnote to table 24 (page 33).

TABLE 33. RELATION OF PERCENTAGE OF MILK SOLD OCTOBER–MARCH TO LABOR INCOME AND OTHER FACTORS, 249 FARMS, 1937

	Grade A farms*			Grade B farms		
	Per cent of milk sold October–March, inclusive			Per cent of milk sold October–March, inclusive		
	Less than 45	45–50	More than 50	Less than 45	45–50	More than 50
Number of farms	39	47	41	60	26	36
Financial returns:						
Farm labor income	$132	$522	$479	–$221	$141	$172
Farm labor earnings	$564	$943	$924	$214	$600	$610
Percentage return on farm capital	–0.5	3.0	3.1	–4.3	1.1	0.1
Labor returns per man	$302	$509	$509	$112	$314	$318
Size of business:						
Productive-man-work units	411	457	462	373	455	467
Number of cows	14.1	16.6	16.3	11.7	15.0	15.6
Average farm capital	$9,462	$10,930	$11,093	$8,400	$9,358	$9,636
Man equivalent	1.7	2.0	2.0	1.8	2.0	1.9
Acres of crops	74	74	81	79	88	87
Milk sold (hundredweight)	768	1,001	1,025	584	948	975
Diversity:						
Per cent of receipts from crops†	11	11	12	15	11	11
Per cent of productive-man-work units on cows	51	54	52	47	50	50
Per cent of productive-man-work units on hay and grain	18	17	18	24	21	20
Per cent of milk sold October–March	39	48	58	38	48	57
Productive-man-work units per acre of crops	5.6	6.2	5.7	4.7	5.2	5.4
Rates of production:						
Milk produced per cow (hundredweight)	62	66	69	56	68	68
Value of milk products sold per cow	$123	$142	$144	$98	$124	$121
Crop index (average for region = 100)	104	107	109	91	105	105
Labor efficiency:						
Productive-man-work units per man	236	233	233	207	229	249
Tons of milk per man	25.0	28.1	28.3	18.1	25.8	28.4
Acres of crops per man	42	38	41	44	44	46
Capital efficiency:						
Capital-receipts ratio†	3.8	3.6	3.5	4.8	3.5	3.7
Per cent of capital in livestock	21	22	22	21	24	24

*The distribution of milk sales was not obtained on 4 of the Grade A farms.
†See corresponding footnote to table 24 (page 33).

50 per cent of their milk during those months. The average labor incomes on the Grade B farms were –$221, $141, and $172, respectively. With an average increase of 1 per cent in quantity sales from October through March, the labor income increased $21 and the labor returns per man increased $11. The return on capital increased from –4.3 per cent in the group selling the smallest proportion of milk during the winter months, to 0.1 per cent in the group selling the largest proportion.

As the proportion of milk sold from October through March increased, the amount of work accomplished increased. A part of the increase in the labor incomes was due to this increase in amount of work done, better labor efficiency, and better rates of crop and milk production, as well as to the higher proportion of milk sales during the months of highest prices.

The percentage of receipts from crops, and the percentage of work units on cows, seemed to have very little, if any, relation to the proportion of milk sales during the winter months.

LABOR EFFICIENCY

Several measures of labor efficiency are commonly used. When the farms studied are dairy farms, the tons of milk produced per man is a satisfactory measure. On crop farms, the acres of crops per man is satisfactory although it does not take into consideration the difference in intensity of the crops. The use of productive-man-work units per man solves this problem, and also makes it possible to compare dairy farms with crop farms since it takes into consideration all of the work accomplished regardless of whether it was on crops, cows, or some other part of the business. This measure of labor efficiency does not take into consideration the fact that better yields of either milk or crops tend to increase the amount of work to be done. Consequently, although the actual pounds of milk or tons of crops handled are greater, a farm which has high rates of milk or crop production may show as poor labor efficiency as will a farm with much poorer rates of production.

Productive-man-work units per man

Of the Grade A farms, only 5, or 4 per cent, had less than 130 productive-man-work units per man, 24 per cent had 130–199 work units per man, 40 per cent had 200–269 work units per man, and 32 per cent had 270 or more work units per man.

The average labor income increased as the productive-man-work units per man increased. There were so few Grade A and Grade B farms—less than 10 in each type—with less than 130 work units per man, that averages are not shown for those farms.

On the Grade A farms the labor incomes in the three groups were $79, $329, and $794, respectively (table 34). With an average increase of 1 work unit per man, the labor income increased $4.47 and the labor returns per man increased $2.38. The return on capital increased from 0.2 per cent to 5.1 per cent as the work units per man increased.

Of the Grade B farms, only 8, or 7 per cent, had less than 130 work units per man, 32 per cent had 130–199 work units per man, 32 per cent had 200–269 work units per man, and 29 per cent had 270 work units or more per man. The labor incomes on the Grade B farms were –$288, –$92, and $412, respectively, in the three groups. With an average increase of 1 work unit per man, the labor income increased $4.40 and the labor returns per man increased $2.35. The return on capital increased from –7.2 per cent in the group with 130–199 work units per man, to 2.7 per cent in the group with 270 or more work units per man.

Of the other dairy farms, 25 per cent had less than 130 work units per man, 44 per cent had 130–199 work units per man, 21 per cent had 200–269 work units per man, and only 10 per cent had 270 or more work units per man. The labor incomes on the other dairy farms were –$273, –$141, –$100, and $7, respectively, in the four groups. With an average increase of 1 work unit per man, the labor income increased $1.35 and the labor returns per man increased $1.13. The return on capital increased from –8.7 in the group with the lowest labor efficiency, to –0.9 in the group with the highest labor efficiency.

There seems to be little, if any, relation of the crop index to labor efficiency as measured by productive-man-work units per man. Production per cow was slightly lower in the groups which had the highest labor efficiency, as these farms had the larger herds.

TABLE 34. Relation of Productive-Man-Work Units per Man to Labor Income and Other Factors, 369 Farms, 1937

	Grade A farms*			Grade B farms*			Other dairy farms			
	Productive-man-work units per man			Productive-man-work units per man			Productive-man-work units per man			
	130–199	200–269	270 or more	130–199	200–269	270 or more	Less than 130	130–199	200–269	270 or more
Number of farms	31	53	42	39	39	36	32	57	27	13
Financial returns:										
Farm labor income	$79	$329	$794	–$288	–$92	$412	–$273	–$141	–$100	$7
Farm labor earnings	$528	$767	$1,219	$157	$352	$875	$107	$293	$349	$555
Percentage return on farm capital	0.2	1.0	5.1	–7.2	–2.2	2.7	–8.7	–5.4	–3.0	–0.9
Labor returns per man	$306	$414	$687	$87	$215	$460	–$36	$52	$86	$199
Size of business:										
Productive-man-work units	338	423	572	324	442	549	150	219	317	462
Number of cows	11.9	15.1	20.2	9.8	14.2	18.6	3.4	3.7	5.7	7.5
Average farm capital	$10,458	$9,472	$12,276	$7,567	$9,264	$10,964	$5,122	$6,349	$7,226	$10,208
Man equivalent	2.1	1.9	1.8	2.0	1.9	1.7	1.5	1.4	1.4	1.5
Acres of crops	61	72	96	70	91	100	42	59	87	114
Animal units, excluding work animals	17.1	20.8	27.3	14.5	20.0	26.0	6.1	7.8	11.4	14.5
Milk sold (hundredweight)	750	920	1,170	549	818	1,074	81	145	211	225
Diversity:										
Per cent of receipts from crops†	9	9	15	13	15	10	27	35	33	40
Per cent of productive-man-work units on hay and grain	18	18	17	25	23	20	30	30	30	29
Per cent of milk sold October–March	51	48	47	44	47	46	....	....	....	....
Rates of production:										
Milk produced per cow (hundredweight)	70	68	64	63	63	63	54	61	59	48
Value of milk products sold per cow	$147	$141	$132	$113	$112	$111	$29	$47	$52	$39
Crop index (average for region = 100)	113	104	110	94	100	98	92	89	93	84
Labor efficiency:										
Productive-man-work units per man	161	226	321	164	231	323	99	154	219	307
Tons of milk per man	19.7	27.3	36.4	15.5	23.3	34.6	6.0	8.0	11.6	12.0
Acres of crops per man	29	38	54	35	47	59	27	42	60	75
Capital efficiency:										
Capital-receipts ratio†	4.1	3.4	3.4	4.5	3.8	3.7	11.1	6.0	5.0	5.1
Per cent of capital in livestock	20	22	23	21	23	25	14	13	16	15

*There were 5 Grade A farms and 8 Grade B farms with less than 130 productive-man-work units per man.

†See corresponding footnote to table 24 (page 33).

Tons of milk per man

Of the Grade A farms, 21 per cent produced less than 20 tons of milk per man, 37 per cent produced 20–29 tons of milk per man, and 42 per cent produced 30 tons of milk or more per man. The average labor incomes in the three groups of Grade A farms were –$289, $232, and $914, respectively (table 35). With an average increase of 1 ton of milk produced per man, the labor income increased $51 and the labor returns per man increased $25. The return on capital increased from –3.3 per cent to 6.5 per cent as the tons of milk produced per man increased.

Of the Grade B farms, 45 per cent produced less than 20 tons of milk per man, 30 per cent produced 20–29 tons of milk per man, and 25 per cent produced 30 tons of milk or more per man. The labor incomes on the Grade B farms were –$367, $25, and $528, respectively, for the three groups. With an average increase of 1 ton of milk per man, the labor income increased $35 and the labor returns per man increased $20. The return on capital increased from –8.0 per cent in the group with the poorest labor efficiency as measured by tons of milk per man, to 3.9 per cent in the group with the highest labor efficiency.

Of the other dairy farms, 94 per cent produced less than 20 tons of milk per man. Only 6 per cent of all the farms in this group produced as much as 20 tons of milk or more per man, and only 1 farm produced more than 30 tons of milk per man. On these other dairy farms, where dairying is relatively unimportant, tons of milk per man is not a very good measure of labor efficiency.

Practically all of the other dairy farms fell in the group with the lowest labor efficiency. Not enough farms were left in the other groups to make averages significant. The average labor income for the group which produced less than 20 tons of milk per man was –$161. This is slightly lower than the average labor income for the Grade A and Grade B farms combined.

A part of the increase in the labor income was probably due to the fact that farms which produced the most milk per man were larger, had higher-producing cows and higher crop yields, and made more efficient use of capital as indicated by the capital employed per man-work unit.

MISCELLANEOUS FACTORS

To name all of the miscellaneous factors affecting labor income would be practically impossible. Only one of these factors, land class, is dealt with here.

Land class

Not enough Grade A, Grade B, and other dairy farms in land classes I, II, and V were found to make comparisons possible for these three types of farms. Practically all of the farms studied were in land classes III and IV. Consequently, only comparisons for these land classes are here shown.

Of the Grade A farms, 103 were located in land classes III and IV (table 36). About one-fifth, or 19 per cent, of all of the Grade A farms were located in land class III, and 60 per cent were located in land class IV. The labor income on the Grade A farms increased from $82 in land class

TABLE 35. RELATION OF TONS OF MILK PER MAN TO LABOR INCOME AND OTHER FACTORS, 374 FARMS, 1937

	Grade A farms			Grade B farms			Other dairy farms*
	Tons of milk per man						
	Less than 20	20–29	30 or more	Less than 20	20–29	30 or more	Less than 20
Number of farms	28	48	55	55	37	30	121
Financial returns:							
Farm labor income	–$289	$232	$914	–$367	$25	$528	–$161
Farm labor earnings	$224	$623	$1,342	$56	$496	$967	$272
Percentage return on farm capital	–3.3	–1.6	6.5	–8.0	–1.5	3.9	–5.0
Labor returns per man	$153	$349	$743	$16	$275	$522	$44
Size of business:							
Productive-man-work units	378	370	537	313	454	569	244
Number of cows	11.4	13.1	20.0	9.3	13.8	21.0	4.2
Average farm capital	$11,132	$8,602	$11,784	$7,153	$9,778	$11,300	$6,588
Man equivalent	2.2	1.8	1.9	1.8	2.0	1.8	1.5
Acres of crops	80	62	86	67	98	95	67
Milk sold (hundredweight)	546	780	1,281	450	825	1,317	128
Diversity:							
Per cent of receipts from crops†	13	9	12	11	18	9	36
Per cent of productive-man-work units on cows	45	53	56	45	46	56	27
Per cent of productive-man-work units on hay and grain	23	17	16	25	24	17	30
Per cent of milk sold October–March	48	48	49	43	48	49	....
Acres of crops per animal unit	4.1	3.0	2.9	4.1	4.3	3.0	6.2
Rates of production:							
Milk produced per cow (hundredweight)	54	66	71	55	65	68	55
Value of milk products sold per cow	$116	$137	$146	$97	$118	$120	$39
Crop index (average for region = 100)	100	106	112	92	101	106	89
Labor efficiency:							
Productive-man-work units per man	176	207	288	171	232	314	166
Tons of milk per man	14.2	24.4	37.9	13.9	23.1	39.2	7.8
Capital efficiency:							
Capital-receipts ratio†	5.0	3.4	3.0	4.9	3.8	3.4	7.2
Per cent of capital in livestock	17	23	23	20	22	27	14
Capital per productive-man-work unit	$29	$23	$22	$23	$22	$20	$27

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*There were only 8 other dairy farms which produced more than 19 tons of milk per man.

†See corresponding footnote to table 24 (page 33).

TABLE 36. RELATION OF LAND CLASS TO LABOR INCOME AND OTHER FACTORS, 349 FARMS, 1937

	Grade A farms*			Grade B farms*		Other dairy farms*	
	Land class			Land class		Land class	
	III	IV	V	III	IV	III	IV
Number of farms	25	78	23	47	59	44	73
Financial returns:							
Farm labor income	$82	$512	$421	–$107	$25	–$185	–$160
Farm labor earnings	$513	$960	$814	$331	$489	$220	$319
Percentage return on farm capital	–1.8	3.2	2.4	–4.5	–0.7	–7.0	–3.8
Labor returns per man	$250	$528	$464	$169	$264	–$12	–$81
Size of business:							
Productive-man-work units	385	476	411	378	471	210	277
Number of cows	13.1	16.7	15.7	12.3	15.3	5.2	4.0
Average farm capital	$8,036	$11,756	$9,857	$7,815	$10,495	$5,352	$7,774
Man equivalent	1.7	2.0	1.9	1.8	2.0	1.3	1.6
Acres of crops	70.1	81.0	65.1	75.0	94.9	52.2	78.6
Animal units, excluding work animals	18.3	23.2	20.9	17.3	21.7	8.5	9.3
Milk sold (hundredweight)	696	1,029	954	694	906	206	118
Diversity:							
Per cent of receipts from crops†	7	14	7	11	13	16	42
Per cent of productive-man-work units on cows	51	52	56	49	49	36	23
Per cent of productive-man-work units on hay and grain	19	17	17	22	22	26	32
Per cent of milk sold October–March	47	48	52	45	47	....	....
Acres of crops per animal unit	3.4	3.1	2.8	3.8	3.8	4.9	6.8
Rates of production:							
Milk produced per cow (hundredweight)	59	68	68	62	65	56	58
Value of milk products sold per cow	$120	$142	$143	$110	$117	$49	$39
Crop index (average for region = 100)	97	111	108	92	104	87	93
Labor efficiency:							
Productive-man-work units per man	230	240	216	208	238	161	175
Tons of milk per man	23	29	28	21	25	11	7
Capital efficiency:							
Capital-receipts ratio†	3.8	3.6	3.5	4.4	4.1	8.1	6.5
Per cent of capital in livestock	23	21	21	23	23	17	13
Capital per productive-man-work unit	$35	$48	$44	$36	$44	$33	$43

*Of the Grade A farms, 5 were located in land class II; of the Grade B farms, 10 were located in land class II, and 6 in land class V; of the other dairy farms, 2 were located in land class I, 7 in land class II, and 3 in land class V.

†See corresponding footnote to table 24 (page 33)

III, to $512 in land class IV. The labor returns per man increased from $250 on the farms in land class III, to $528 on the farms in land class IV, and the return on capital increased from –1.8 per cent to 3.2 per cent.

Of the Grade B farms, 106 were located in land classes III and IV. About 39 per cent of all the Grade B farms were located in land class III, and 48 per cent were located in land class IV. The labor income on the Grade B farms increased from –$107 for the farms in land class III, to $25 for the farms in land class IV. The labor returns per man increased from $169 to $264, and the return on capital increased from –4.5 to –0.7 per cent, for the farms in these two respective land classes.

Of the other dairy farms, 117 were located in land classes III and IV. The farms in land class III made up 34 per cent of all the other dairy farms, and those in land class IV made up 57 per cent. The labor income on the other dairy farms showed no significant increase for the farms in land class IV as compared with those in land class III, the increase being from –$185 in land class III to –$160 in land class IV. The labor returns per man actually declined, from –$12 on the farms in land class III to –$81 on the farms in land class IV. Poor markets and an extensive system of farming result in higher losses on the more expensive land of a high land class, than on a low land class.

Since the farms in land class IV had larger businesses, higher production per cow, better crop yields, and better labor efficiency, and derived a higher proportion of their receipts from the sale of crops, than did the farms in land class III, much of the higher returns on those farms was due to better farm organization.

The farms in land class IV employed more capital per productive-man-work unit than did the farms in land class III. The receipts were enough larger, however, on the farms in land class IV so that the time required for the receipts to equal the amount of capital employed was less in land class IV than in land class III.

COMBINATION OF FACTORS

The effect of different business-organization factors on farm profits varies with different types of farming. High production per cow is much more effective on Grade A farms than on other dairy farms. To have good crop yields is more important to other dairy farms or to crop farms, than to Grade A farms.

The three types of dairy farms were sorted and subsorted on the basis of four of the most important factors. These were total productive-man-work units, productive-man-work units per man, production per cow, and crop index. Although the number of farms in each group is small, some indication of the relative importance of the four factors in their effect on labor income is shown in table 37 for each of the three types of farming.

Those farms which were below average in all four of the factors, made average labor incomes of –$194 on the Grade A farms, –$532 on the Grade B farms, and –$389 on the other dairy farms.

Those farms which were average or above average in at least one of the four factors, made average labor incomes of –$88 on the Grade A farms, –$375 on the Grade B farms, and –$142 on the other dairy farms.

Those farms which were average or above average in at least two of the

TABLE 37. RELATION OF THE NUMBER OF FACTORS THAT ARE AVERAGE OR ABOVE, TO THE LABOR INCOME, BY TYPES OF FARMING, 382 FARMS, 1937

	Grade A farms		Grade B farms		Other dairy farms	
	Farms	Labor income	Farms	Labor income	Farms	Labor income
	Number	*Dollars*	*Number*	*Dollars*	*Number*	*Dollars*
No factors above average	6	–194	10	–532	11	–389
One factor above average	27	–88	35	–375	34	–142
Two factors above average	59	284	34	–43	36	–259
Three factors above average	24	736	23	175	35	–91
Four factors above average	15	1,493	20	624	13	176

four factors, made average labor incomes of $284 on the Grade A farms, –$43 on the Grade B farms, and –$259 on the other dairy farms.

Those farms which were average or above average in at least three of the four factors, made average labor incomes of $736 on the Grade A farms, $175 on the Grade B farms, and –$91 on the other dairy farms.

Those farms which were average or above average in all of the four factors, made average labor incomes of $1493 on the Grade A farms, $624 on the Grade B farms, and $176 on the other dairy farms.

There was an average increase of $141 in labor income for each additional factor as good as or better than the average for all farms.

BUSINESS–ANALYSIS FACTORS

The business-analysis factors for the different types of farming are given in table 38.

TABLE 38. BUSINESS-ANALYSIS FACTORS, BY TYPES OF FARMING, 453 FARMS, 1937

	Grade A farms	Grade B farms	Other dairy farms	Poultry farms	Miscellaneous-type farms
Number of farms	131	122	129	40	31
Financial returns:					
Farm labor income	$407	–$28	–$150	$282	$29
Farm labor earnings	$840	$413	$285	$759	$470
Percentage return on farm capital	2.2	–2.2	–4.8	1.0	–1.9
Labor returns per man	$464	$219	$52	$412	$158
Operator's labor income	$402	–$27	–$136	$248	$46
Landlord's percentage return on capital	5.2	4.7	3.1	9.3	3.1
Size of business:					
Productive-man-work units	442	418	247	396	248
Man equivalent	1.9	1.9	1.5	1.8	1.5
Number of cows	15.6	13.5	4.4	5.9	2.7
Number of hens	58	93	98	656	121
Animal units, excluding work animals	21.6	19.3	8.8	16.0	7.6
Total animal units	24.3	22.1	11.1	18.0	9.7
Milk produced (hundredweight)	1,042	854	253	400	146
Milk sold (hundredweight)	940	778	151	312	76
Acres of crops	76	83	66	79	67
Total acres operated	149	168	112	124	128
Average farm capital	$10,479	$8,969	$6,617	$9,210	$7,129
Diversity:					
Per cent of productive-man-work units on cows	53	49	28	22	16
Per cent of productive-man-work units on hay and grain	17	22	30	24	31
Per cent of productive-man-work units on crops	38	40	54	40	64
Productive-man-work units per acre of crops	6	5	4	5	4
Per cent of milk sold October–March	49	46	......	......	......

(Table 38 is concluded on the following page)

TABLE 38 (*concluded*)

	Grade A farms	Grade B farms	Other dairy farms	Poultry farms	Miscellaneous-type farms
Number of farms	131	122	129	40	31
Rates of production:					
Milk produced per cow (hundredweight)	67	63	57	68	55
Value of milk products sold per cow	$139	$112	$44	$116	$44
Average butterfat test of milk sold (per cent)	4.0	3.9	......	......	......
Crop index (average for region = 100)	107	98	90	98	89
Dozens of eggs sold per hen	9	9	10	12	10
Value of eggs sold per hen	$2.03	$2.40	$2.59	$3.11	$2.45
Labor efficiency:					
Productive-man-work units per man	233	224	169	219	163
Tons of milk per man	27.5	22.9	8.7	11.1	4.8
Acres of crops per man	40	45	45	44	44
Number of cows per man	8.2	7.3	3.0	3.3	1.8
Number of animal units, excluding work animals, per man	11.4	10.3	6.0	8.8	5.0
Capital efficiency:					
Capital-receipts ratio	3.3	3.6	5.2	2.3	4.6
Capital per productive-man-work unit	$24	$21	$27	$23	$29
Capital per man	$5,526	$4,812	$4,531	$5,095	$4,702
Per cent of capital in livestock	22	23	14	19	11
Per cent of capital in real estate	65	61	73	63	78
Fertility:					
Acres of crops fertilized	25	31	24	36	25
Cost of fertilizer	$84	$85	$56	$98	$88
Tons of manure available per acre of crops	2.6	2.1	1.3	1.8	1.2
Cost of fertilizer per acre of crops	$1.11	$1.03	$0.84	$1.25	$1.32
Receipts:					
Milk products sold	$2,169	$1,518	$193	$682	$117
Crops sold	$357	$308	$438	$515	$731
Eggs sold	$117	$223	$254	$2,041	$296
Miscellaneous receipts	$109	$94	$85	$92	$109
Total receipts	$3,206	$2,504	$1,281	$3,972	$1,558
Per cent of receipts from milk products sold	68	61	15	17	7
Per cent of receipts from crops sold	11	12	34	13	47
Per cent of receipts from eggs sold	4	9	20	51	19
Per cent of receipts from miscellaneous sources	3	4	7	2	7
Expenses:					
Feed	$564	$482	$185	$1,458	$209
Labor, except operator	$473	$428	$227	$463	$211
Total expense	$2,275	$2,083	$1,100	$3,230	$1,173
Per cent of expense for feed	25	23	17	45	18
Per cent of expense for labor, except operator	21	21	21	14	18
Miscellaneous factors:					
Age of operator (years)	51	49	55	53	54
Value of operator's time	$696	$615	$498	$650	$517
Value of real estate per acre of cropland	$98	$70	$80	$81	$89
Value of total capital per acre of cropland	$149	$114	$109	$129	$115
Value of real estate per acre operated	$46	$33	$43	$46	$43
Value of total capital per acre operated	$71	$53	$59	$74	$56
Number of horses	2.7	2.8	2.2	2.2	2.2
Per cent of farms having trucks	37	25	16	22	13
Per cent of farms having tractors	50	52	36	65	45

VARIATION IN IMPORTANT BUSINESS FACTORS

The number of farms with different values for each of several business factors are given in table 39, by types of farming.

TABLE 39. Variation in Factors, by Types of Farming, 453 Farms, 1937

Range	Proportion of total number				
	131 Grade A farms	122 Grade B farms	129 other dairy farms	40 poultry farms	31 miscellaneous-type farms
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Dollars of labor income per farm:					
Less than −1,500	1	1	1	2	..
−1,500 to −1,001	4	8	2	2	..
−1,000 to −501	8	10	15	13	10
−500 to −1	14	37	47	20	42
0 to 499	28	28	26	32	35
500 to 999	26	10	8	8	7
1,000 to 1,499	11	3	..	10	3
1,500 to 1,999	5	2	1	13	..
More than 1,999	3	1	..	..	3
Total	100	100	100	100	100
Dollars of labor returns per man:					
Less than 60	1	4	5	5	3
60–79	4	6	16	5	16
80–99	8	17	27	8	23
100–119	11	22	27	22	29
120–139	21	29	12	15	16
140–159	22	10	9	22	..
160–179	17	6	3	..	7
180–199	7	4	..	8	3
More than 199	9	2	1	15	3
Total	100	100	100	100	100
Number of cows per farm:					
Less than 5	4	2	65	58	78
5–9	14	30	29	20	19
10–14	41	37	5	12	3
15–19	18	13	1	5	..
20–24	12	11	..	5	..
25–29	5	2	..	..	..
30–34	3	2	..	..	..
35–39	1	2	..	..	..
More than 39	2	1	..	..	..
Total	100	100	100	100	100
Number of animal units, excluding work animals, per farm:					
Less than 10	8	9	60	28	61
10–19	46	55	34	43	32
20–29	30	24	5	22	7
30–39	10	6	1	5	..
More than 39	6	6	..	2	..
Total	100	100	100	100	100
Number of total productive-man-work units per farm:					
Less than 200	8	3	42	15	42
200–299	19	24	30	20	19
300–399	20	27	13	18	13
400–499	26	16	6	27	10
500–599	11	15	7	8	6
More than 599	16	15	2	12	10
Total	100	100	100	100	100
Number of men per farm:					
Less than 1.5	39	30	66	40	65
1.5–1.9	12	26	14	20	13
2.0–2.4	33	28	15	28	13
2.5–2.9	3	11	2	5	6
3.0–3.4	8	2	..	5	..
3.5–3.9	1	2	1	..	3
4.0–4.4	2	1	1	2	..
4.5–4.9	..	..	..	..	..
More than 4.9	2	..	1	..	..
Total	100	100	100	100	100

TABLE 39 (*continued*)

Range	Proportion of total number				
	131 Grade A farms	122 Grade B farms	129 other dairy farms	40 poultry farms	31 miscellaneous-type farms
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Acres of crops per farm:					
Less than 40	14	7	31	30	39
40–59	25	26	29	17	13
60–79	22	18	17	15	23
80–99	16	23	5	5	10
100–119	12	10	8	10	3
120–139	5	6	2	8	6
140–159	3	6	2	8	..
More than 159	3	4	6	7	6
Total	100	100	100	100	100
Dollars of total farm capital per farm:					
Less than 2,000	..	..	1	..	3
2,000–3,999	3	5	21	5	29
4,000–5,999	16	20	34	18	23
6,000–7,999	23	20	19	27	13
8,000–9,999	13	24	10	15	13
10,000–11,999	13	11	4	10	7
12,000–13,999	13	10	5	10	3
14,000–15,999	7	6	2	5	3
16,000–17,999	4	3	2	5	..
18,000–19,999	2	..	2	3	3
More than 19,999	6	1	..	2	3
Total	100	100	100	100	100
Hundredweight of milk produced per farm:					
Less than 400	6	13	83	70	94
400–599	13	26	13	5	..
600–799	19	24	3	8	3
800–999	21	11	..	2	3
1,000–1,199	13	8	1	8	..
1,200–1,399	8	7	..	5	..
1,400–1,599	8	2	..	2	..
1,600–1,799	3	2	..	..	..
More than 1,799	9	7	..	..	..
Total	100	100	100	100	100
Hundredweight of milk sold per farm:					
Less than 400	8	17	90	73	97
400–599	18	30	8	5	..
600–799	21	20	2	8	..
800–999	21	11	..	5	3
1,000–1,199	9	7	..	2	..
1,200–1,399	8	6	..	5	..
1,400–1,599	5	1	..	2	..
1,600–1,799	5	3	..	..	..
More than 1,799	5	5	..	..	..
Total	100	100	100	100	100
Dollars of milk products sold per farm:					
Less than 250	..	..	72	60	81
250–499	2	3	18	5	10
500–749	1	10	6	5	6
750–999	8	24	2	3	..
1,000–1,499	23	29	2	10	3
1,500–1,999	17	14	..	3	..
2,000–2,499	19	8	..	2	..
2,500–2,999	13	4	..	10	..
3,000–3,499	5	4	..	..	..
3,500–3,999	7	2	..	2	..
More than 3,999	5	2	..	..	..
Total	100	100	100	100	100

TABLE 39 (*continued*)

Range	Proportion of total number				
	131 Grade A farms	122 Grade B farms	129 other dairy farms	40 poultry farms	31 miscellaneous-type farms
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Hundredweight of milk produced per cow:					
Less than 30	1	2	7	..	49
30–39	2	4	13	8	10
40–49	7	13	13	5	3
50–59	15	20	19	28	6
60–69	31	28	13	15	6
70–79	24	23	13	22	13
80–89	10	6	8	15	..
90–99	6	2	5	2	3
More than 99	4	2	9	5	10
Total	100	100	100	100	100
Crop index:					
Less than 70	5	10	22	20	32
70–79	11	8	13	10	10
80–89	11	18	16	10	16
90–99	15	21	13	5	13
100–109	18	15	14	10	6
110–119	12	12	13	23	10
120–129	11	5	3	12	10
130–139	6	6	5	10	..
140–149	4	2	..	..	..
More than 149	7	3	1	..	3
Total	100	100	100	100	100
Per cent of milk sold October–March:					
Less than 40	10	26			
40–49	45	38			
50–59	33	25			
More than 59	9	11			
Unknown	3	..			
Total	100	100			
Per cent of productive-man-work units on cows:					
Less than 10	..	..	10	28	51
10–19	..	1	20	30	13
20–29	2	2	21	18	23
30–39	8	17	23	10	3
40–49	24	34	19	12	10
50–59	41	30	4	..	..
More than 59	25	16	3	2	..
Total	100	100	100	100	100
Tons of milk per man:					
Less than 10	2	3	62	60	78
10–19	19	42	32	22	19
20–29	37	30	5	8	3
30–39	25	17	1	5	..
40–49	15	5	..	5	..
50–59	2	1	..	..	..
More than 59	..	2	..	..	..
Total	100	100	100	100	100
Number of productive-man-work units per man:					
Less than 120	2	5	19	5	32
120–159	11	12	31	10	23
160–199	15	21	19	27	10
200–239	25	16	16	25	19
240–279	20	22	10	12	10
280–319	9	12	3	8	3
320–359	12	4	..	5	..
More than 359	6	8	2	8	3
Total	100	100	100	100	100

TABLE 39 (*concluded*)

Range	Proportion of total number				
	131 Grade A farms	122 Grade B farms	129 other dairy farms	40 poultry farms	31 miscellaneous-type farms
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Age of operator (years):					
Less than 30	7	5	4	..	..
30–39	11	17	9	13	13
40–49	25	29	14	30	23
50–59	31	21	29	30	32
60–69	17	25	32	18	23
More than 69	8	3	12	8	9
Not obtained	1	..	..	1	..
Total	100	100	100	100	100
Dollars of expense for labor, per farm:					
Less than 100	23	16	44	18	45
100–299	19	23	28	25	29
300–499	18	25	15	23	13
500–699	18	18	8	10	7
700–899	10	7	3	12	3
More than 899	12	11	2	12	3
Total	100	100	100	100	100
Dollars of purchased fertilizer, per farm:					
Less than 20	15	20	42	18	39
20–39	17	11	15	10	19
40–59	17	14	12	15	3
60–79	14	11	5	7	10
80–99	11	9	8	7	13
100–199	18	24	11	30	13
More than 199	8	11	7	13	3
Total	100	100	100	100	100

ARBITRARY STANDARD FOR A SUCCESSFUL FARM

Every farm should strive to maintain a high standard if the business is to be profitable. To be the most profitable, farms should have favorable size of business, diversity of business, high rates of production, good labor efficiency, and efficient use of capital.

SIZE OF BUSINESS

1. A herd of 20 cows or more is desirable for both Grade A and Grade B farms. Large businesses are the most profitable if they are supported by high rates of production, efficient use of labor, and favorable prices.

2. Dairy farms should have 100 acres or more of crops.

3. Grade A and Grade B farms should strive for businesses of 600 or more productive-man-work units.

4. No more capital should be used than is necessary to provide good land, satisfactory buildings and equipment, and good livestock. On Tompkins County farms, $12,000–$13,999 was required with the size of business indicated above.

5. Approximately 2.0 men, with some help in harvest, are required to operate a dairy farm of this size.

DIVERSITY OF BUSINESS

6. As large a proportion of the milk as is possible should be produced in the winter months.

7. A ratio of not more than 3.0 to 3.5 acres of crops for each animal unit kept should be maintained.

8. Farms should have a relatively small proportion of their total work units on hay and grain, in order to provide satisfactory rotations and labor efficiency.

9. Advantage should be taken of any opportunity to get better-than-average prices for products to be sold. Premiums should be obtained, if possible.

RATES OF PRODUCTION

10. Production should be 7000 pounds or more of milk per cow. For Grade A farms, the butterfat test should average 4.0 per cent.

11. Yields of the important crops should be from 10 to 40 per cent above the average for the region.

12. Where poultry is a minor enterprise, at least 10 dozens of eggs per hen should be produced; where it is the major enterprise, at least 12 dozens per hen should be produced.

LABOR EFFICIENCY

13. Grade A and Grade B farms should produce 35 tons or more of milk per man.

14. Grade A and Grade B farms should have 300 or more productive-man-work units per man.

15. Grade A and Grade B farms should have as near to 40 acres or more of crops per man as is possible, depending on the crop index and the cropping system.

CAPITAL EFFICIENCY

16. The total capital employed should be such that receipts would equal the capital in 3.5 years or less, on Grade A and Grade B farms.

17. From 10 to 15 per cent of the capital employed should be invested in cows.

18. Grade A farms should operate on not more than $24 in capital per man-work unit. Grade B farms should operate on not more than $20 in capital per man-work unit.

SUMMARY

1. Financial records on 544 farms in Tompkins County, New York, for the year ended on March 31, 1938, furnished the data for this study. The records were taken by the survey method.

2. The study was made to ascertain what factors affected labor incomes in the area in 1937, and to find out which of these factors were the most important.

3. Because of the differences in prices and the resulting effect on incomes, the farms were divided into groups on the basis of the type of market for milk, the main product in the area. But all of the farms in each of these groups which had as many as 400 hens or more were analyzed in a separate group, as poultry farms. Also, the records of farms which received as much as $250 or more of outside income or whose receipts differed noticeably from those on most of the farms, were analyzed separately as "special" records.

4. There resulted 131 farms which sold Grade A milk, 122 which sold Grade B milk, 129 which sold milk only to their neighbors or which sold cream, butter, or veals, 40 which kept 400 hens or more, 31 which sold very little milk with no particular outlet or else sold no milk at all, and 91 which were classified as special farms.

5. Dairy cattle made up 84 per cent of the total animal units on the farms selling Grade A milk, 81 per cent on the farms selling Grade B milk, 57 per cent on the other dairy farms, 47 per cent on the poultry farms, 41 per cent on the miscellaneous-type farms, and 70 per cent on the special farms.

6. Farms which sold Grade A milk kept an average of 15.6 cows, as compared with 13.5 on the farms selling Grade B milk, 4.4 on the other dairy farms, 5.9 on the poultry farms, 2.7 on the miscellaneous-type farms, and 8.6 on the special farms. Of all the cows in the area, 80 per cent were on farms selling Grade A or Grade B milk.

7. The average number of hens kept on the poultry farms was 656. On the other types of farms, the average number of hens ranged from 58 on the farms which sold Grade A milk, to 156 on the special farms.

8. Other kinds of livestock were not important. An average of less than one animal unit of beef cattle was kept per farm. Sheep were most important on the miscellaneous-type farms, where an average of 8.5 ewes were kept. Hogs were unimportant except as they were kept for home butchering. About half of the farms raised one or two hogs a year for this purpose.

9. The average number of acres operated on the farms studied was 140. Approximately half of the total acreage was used for the production of crops, 32 per cent was used for pasture, 9 per cent was in woods not pastured, and 6 per cent was left idle. The farmsteads, roads, and fences occupied about 4 per cent of the total acreage.

10. Of the acreage used for the production of crops, about 14 per cent was used for intertilled crops, 32 per cent for small grains, and 49 per cent for hay.

11. The principal crops grown were corn for silage, corn for grain, potatoes, cabbage, field beans, oats, oats and barley, buckwheat, wheat, alfalfa, clover and mixed hay, and timothy.

12. Approximately one-fourth of the farms had trucks and one-half of them had tractors. The farms with tractors were larger, and had better labor efficiency, than those depending on horses for power.

13. The average amount of capital employed was $10,479 on the farms that sold Grade A milk, $8969 on the farms that sold Grade B milk, $6617 on the other dairy farms, $9210 on the poultry farms, $7129 on the miscellaneous-type farms, and $8751 on the special farms.

14. Of the total amount of capital employed, approximately 66 per cent was in real estate, 20 per cent was in livestock, 12 per cent was in equipment, and 2 per cent was in feed and supplies. The farms where dairying was less intensive had a higher proportion of the total capital in real estate, and a smaller proportion in livestock, than did the intensive dairy farms.

15. Of the capital in real estate, 42 per cent was in land, 25 per cent was in the operator's house, and 33 per cent was in other buildings.

16. The receipts were $3206 per farm on the farms that sold Grade A milk, $2504 on the farms that sold Grade B milk, $1281 on the other dairy

farms, $3972 on the poultry farms, $1558 on the miscellaneous-type farms, and $3373 on the special farms.

17. The major proportion of the income was derived from the sale of market milk on the Grade A and Grade B farms, from the sale of crops and eggs on the other dairy and the miscellaneous-type farms, from the sale of eggs on the poultry farms, and from work off the farm and the sale of market milk on the special farms.

18. The expenses were $2275 on the farms that sold Grade A milk, $2083 on the farms that sold Grade B milk, $1100 on the other dairy farms, $3230 on the poultry farms, $1173 on the miscellaneous-type farms, and $2387 on the special farms.

19. Expenses for labor, feed and bedding, and machinery made up approximately two-thirds of the total expenses.

20. The average labor incomes were $407 on the farms that sold Grade A milk, –$28 on the farms that sold Grade B milk, –$150 on the other dairy farms, $282 on the poultry farms, $29 on the miscellaneous-type farms, and $548 on the special farms.

21. The use of the house, and products furnished by the farm which were used by the operator's family, amounted to approximately $430 per farm. Milk, garden, and firewood were the most important farm products from the standpoint of value. The operator's labor earnings were higher than labor income by about this amount, for each group of farms.

22. The differences in prices received for products sold were important in causing variations in labor income between types of farming.

23. Size of business, milk produced per cow, crop yields, and labor efficiency, were four of the most important factors affecting labor income. The farms which were below average in all of these factors, made average labor incomes of –$194 on the farms that sold Grade A milk, –$532 on the farms that sold Grade B milk, and –$389 on the other dairy farms. The farms which were average or above average in all four of these factors, made average labor incomes of $1493 on the farms that sold Grade A milk, $624 on the farms that sold Grade B milk, and $176 on the other dairy farms.

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Selective Factors in Migration from a New York Rural Community

Amy A. Gessner

In cooperation with
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United States Department of Agriculture

UNION ACADEMY OF BELLEVILLE

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SELECTIVE FACTORS IN MIGRATION FROM A NEW YORK RURAL COMMUNITY[1]

Amy A. Gessner

THE PROBLEM AND METHODS

IMPORTANCE OF RURAL-URBAN MIGRATION

Rural-urban migration has been a matter of concern since the beginning of the growth of modern cities. It is a problem which has troubled all the western nations for the past forty years. As early as 1896 Liberty Hyde Bailey wrote:

> One of the chief difficulties is the failure of country life as it exists at present to satisfy the higher social and intellectual aspirations of country people. Whether the constant draining away of so much of the best elements in the rural population into the towns is due chiefly to this cause or to the superior business opportunities of city life may be open to question, but no one can fail to recognize the necessity for building up the life of the farm upon its social as well as upon its productive side.[2]

This problem became increasingly troubling and focused attention upon the differential in satisfactions from rural and urban life. One result of the widespread concern over urbanward migration was the initiation of the country-life movement with its effort to enrich rural life through community organization. In his opening address to the First Wisconsin Country Life Conference, Dean Harry L. Russell said:

> Social sterility and temperamental attitude of mind have been in large measure, the primary cause for the drainage of the larger part of the vital resources of the country to the city. The necessity for stemming this tide is now recognized more forcibly than ever before. In order that the country shall continue to supply the city with brains, the virility of the original stock must be kept unimpaired, and to do this we must have some of the best remain in the country. Only when the country supplies the wants and needs of man, social and intellectual, as well as physical and material, when the prizes of the game of life are awarded in proportionate measures to those outside urban walls, then and then only will the call of the farm exert a sufficiently strong influence to hold a fair proportion of country youth.[3]

Tremendous change has come to rural areas, as well as to the nation as a whole, since these first alarms were sounded. How have these changes affected the character of the migration from rural areas? Has increased accessibility for rural people to the comforts of urban areas changed the trend which was so marked three decades ago? There is no simple answer to this question, so complex have been the forces operating upon agriculture and rural life since that time.

Many studies have been made of rural migration, with diverse conclusions regarding the selective nature of this migration. This diversity does not appear to be associated with time and the changes it brings, since recent studies differ among themselves rather than with earlier studies.

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[1] This bulletin is a condensation of the first part of a thesis presented to the Faculty of the Graduate School of Cornell University, September 1939, in partial fulfillment of the requirements for the degree of doctor of philosophy.

[2] Bailey, Liberty Hyde. Report of the Roosevelt Commission on Country Life. (Reference on p. 16.) February 9, 1907.

[3] First Wisconsin Country Life Conference. Univ. Wisconsin. Bul. 472. (Reference on p. 10.) February 1911.

The present study was designed to make a contribution to the research methods involved and to ascertain the facts for Belleville, and not to make any generalizations from the data for a single community.

Only one of the studies need be cited here, the first one made in the Belleville, New York, area.[4] It was not a study of selectivity, but rather of the amount of migration from the community, the distance of migration, and the achievements of some of the migrants, illustrating the importance of the rural community, "the very seed bed of national life." No comparisons were drawn between those who had remained in the community and those who had left except in the matter of occupation. However, the conclusion was drawn that because certain strong families had persisted in the community, and "community life itself has been positive, virile and progressive" folk depletion had not occurred as a result of migration. The group studied included all graduates of the local academy during the ninety-six years of its history.

It is a well-established fact that the whole population of the nation depends upon the quality of that in rural areas. These areas produce the surplus which fills in the ranks of urban dwellers who do not replace their numbers. If the city's superior opportunities, economic, educational, and social, have been causing folk depletion, all the nation's efforts to subsidize agriculture, to provide better educational opportunity, and to aid the community in enriching its own social and cultural life must be regarded as indispensable to maintaining the nation, for by these means are the rural communities made attractive to the able and ambitious.

THE PROBLEM

The object of this study was to answer two questions:

1. Are selective factors operating in the migration of rural young people from the community in which they were reared?
2. Are selective factors operating to differentiate between those who migrate to other rural areas and those who go to urban areas?

THE AREA STUDIED

The rural community of Belleville, New York, was selected as the field in which to seek the answer to the questions stated above for two major reasons. First, because this was the area covered by the earlier study.[5] Here was an opportunity to make some observations of the effects of time upon the extent and character of migration.

The second reason was the interest of the citizens themselves in the possible findings. Changes in such institutions as the church, the grange, and other organizations which once flourished in the community led those long resident there to question whether these changes were the effect of migration. So interested were the community leaders in this problem that they voted a portion of the income from the endowment fund of the local academy to aid in the study.

Two areas are covered by this study, one contained within the other. The first is the centralized school district of Union Academy, which includes the village of Belleville and the area within a five-mile radius on all

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[4] The national influence of a single farm community. By Emily F. Hoag. U. S. Agr. Dept. Bul. 984. 1921.

[5] See footnote 4.

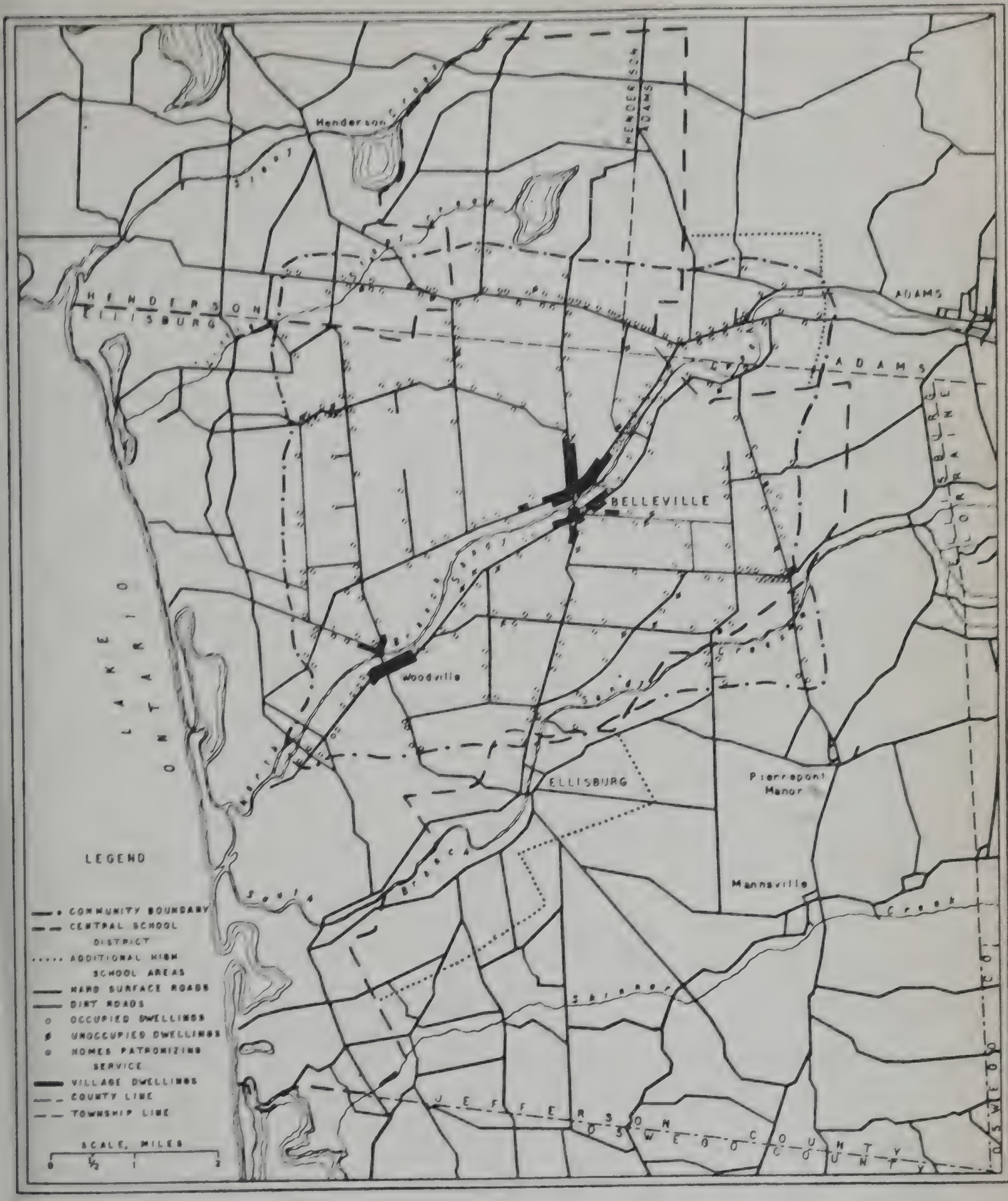

FIGURE 1. THE BELLEVILLE COMMUNITY AND THE CENTRAL-SCHOOL DISTRICT

sides except the east, where it is limited to two or three miles. This school district covers parts of the towns of Ellisburg, Henderson, and Adams, in the southwestern corner of Jefferson County. The town of Ellisburg is bounded on the west by Lake Ontario, just south of Henderson Harbor. The second area is the Belleville community, the northern and eastern portion of the school district, and centering about the village of Belleville for a radius of three to five miles. This is the area from which most of the students came when the academy was a private school, and which Miss Hoag used for a large part of her study; the same boundaries were used in this study so that the data might be comparable.

Galpin, in *My Drift into Rural Sociology*, speaks of the village of Belleville as "a small hamlet—a spot of trade in among the farms of a great dairy country".[6] This is the richest agricultural area of the county and one of the best in the State. The western part of the area closer to the lake is sandy and not quite so desirable agriculturally as the section farther east. The smaller area of the community, as contrasted with that of the district, includes none of the sandy soil; all the soil is of superior quality.

The village itself, with a population of a little more than 300, is no longer incorporated. It serves a limited trade area for groceries, garage service, church, and grange. Its school area is considerably larger than its trade area. It lies five miles west of Adams, a growing trade center of 1600, which includes the Belleville community in its banking, milk-marketing, and motion-picture area. Belleville is 25 miles south of Watertown, the county seat, a prosperous city of 32,000 which is a shopping and medical center for a large area, including Belleville. A few of the residents of the Belleville area drive to work in Watertown each day.

Belleville is an old and long-established community, rich in history and tradition, particularly its tradition for education. Its early settlers from eastern New York and New England brought to it a high regard for education and religion. First settled in 1802, it had a school by 1805, and the Baptist church was organized in 1807. The Union Academy, around which the community's life has always centered, had its beginnings in 1824, then under the name of the Union Literary Society.

The character of the population which this community had attracted to it was evidenced in the support which it gave this school. The present endowment fund is $74,000. But the value which the citizens placed upon education was also evidenced in the steady increase in enrollment. The majority of those attending have been the sons and daughters of farmers, and farmers have supported and controlled it.

THE METHOD OF STUDY

It is probable that no other trait is more valued in society today than mental ability. There could be no more significant thing on which to compare the migrant with the non-migrant in the community's own terms. But the widely accepted measure of mental ability, the intelligence-test score, was not available. However, complete records of high-school grades could be obtained for the younger migrants. Only those who had spent one year or more at Union Academy between the years 1919 to 1938 were included in the study. The study was begun with the year 1919 because Miss Hoag's study covered up to that time. The data were gathered in July and August of 1938, which set the upper limit of the study.

A card was made for each student who had entered the academy between 1919 and 1938 and remained one year or more. The alumni records, the principal of the school, old residents, and relatives of the one-time student were consulted for information regarding the address and occupation of the student. Of course, many of the students were still in the community area and their homes were visited in the process of the field study described below. Those who were not reached by the field schedule were sent a questionnaire and a letter asking for their cooperation. Satisfactory comparison between the migrant and non-migrant young people could have been made only on the basis of achievement in high school as measured by grades, and by age and sex, all of which were available from the school records. However, it was deemed advisable to send the questionnaire to each student to check the information on his present place of residence as furnished by the local citizens and to obtain additional information. A summary of the questionnaire returns is given under the description of the sample.

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[6] Galpin, Charles J. My drift into rural sociology, p. 5. Univ. Louisiana Press. 1938.

The students were also listed on tabulation sheets according to the calendar year in which they entered Union Academy. Age and sex were recorded. Averages for each year's work while at Union Academy were computed and entered for each student. The classes averaged 26 pupils for each grade. The student was given a rank for each year's work, depending upon his position in relation to his fellow classmates. Then these ranks were averaged to give him an average rank for his whole high-school career. The next step was to group the class with which he finished into fourths according to rank, and his final position was thus established on the basis of his average rank in an upper or lower fourth of the class. For example, a student might rank second in his freshman year, fourth as a sophomore, fourth as a junior, and second in his senior year. This would give him an average rank of third, which would put him in the top fourth in any of the classes.

Students who did not complete a full academic year were not included because of insufficient records for averaging and ranking. However, because students who had spent but one year were included, the final position for some was established on the basis of fewer years' work than for others. Courses of study differed to some extent for different students, but in a school of this size, a little more than 100 pupils, on the average, there is not a great variety of offerings.

The second major phase of this study (not fully reported in this bulletin), the comparison of the families long established in the community with the more recent immigrants, was approached by the use of a field schedule. These schedules contributed data on the parental homes, which were compared with information about those migrant and non-migrant students whose homes were covered by the study.

The data from the returned questionnaires, field schedules, and school records were transferred to Hollerith cards, and tabulations were made by machine.

THE SAMPLE STUDIED

The high-school records supplied data on a total of 494 students who entered between September 1919 and September 1938. There was a preponderance of females among them, in accordance with the expectation for rural high schools. Their present ages range from 15 to 37 with an average age of 25 years. Of this total, 75 are still attending Union Academy, 243 have left the school district, and 173 are still in the district. Of these 173, 17 are away at school but their parents are still in the district and the students are not considered as having left. Of the 243 who have left, 8 are still in high school, and 2 are attending trade school or college.

Present distribution of 494 students of Union Academy, 1919–38

Still attending Union Academy	75
Deceased	3
Left school district	243
Still in school district	173

No address was obtainable for 18 of the former students who had left the area, and no questionnaires were sent to those still in high school. Therefore questionnaires were sent to 217 of those who had left. Questionnaires were sent to 54 of the 173 still in the school district because they were not in the area covered by the field schedule. Replies were received from 69 of the 217 and from 13 of the 54. Fourteen questionnaires addressed to those who had left the district were returned because of incorrect address. Therefore 82 replies were returned from the 257 who actually received questionnaires, making a return of 32 per cent for the data on the questionnaires.

The facts concerning migration and school rank did not depend on the questionnaires, but involved more than two-thirds of the total pupils studied. The 83 students still in high school and the three who had died have not been included in the tabulations. For the purpose of this report it was also decided to omit the 69 former students who left the community with their parents, because they did not migrate voluntarily. This leaves a basic sample of 339, or 68 per cent of the total, for whom data on migration and school ranks are available. The samples for the other factors vary, depending upon the source of information concerning them. Information on all factors analyzed is available for the 105 students covered by the field schedule. Almost complete information was obtained about the 82 who answered the questionnaires. Some factors were covered for the 43 students who had left the area, and who did not answer the questionnaire, but whose parents were included in the area of field study. Consequently the sample reported on varies from factor to factor. Where failure to obtain data on a certain factor for the whole group introduces a possible bias, this is discussed in connection with that factor.

Families in the community

The field schedule was obtained from 397 families, all except one resident in the area included within the boundaries established in Miss Hoag's study. Though the community boundaries have changed, as explained in the section on the community, it seemed desirable to follow the limits set by the previous study for the sake of comparison.

Two hundred of these families lived on farms in the open country, 63 in non-farm homes in the open country, 117 in village homes in Belleville or Woodville, and 17 in farm homes within the village limits. Neither Belleville nor Woodville is an incorporated village, but for Belleville the limits of the now dissolved corporation were applied, and in Woodville, those homes which were closely centered about the service agencies of the hamlet were classified as village homes.

This field schedule included data on the membership of the family, tenure status, income, mobility, organization membership and participation, trade centers patronized, residence, occupation, and education of sons and daughters who had left the community.

FACTORS AFFECTING MIGRATION

EXTENT OF MIGRATION

For more than a century Union Academy has been training the boys and girls of the Belleville community for life on the farms and in the villages of the community as well as in distant cities and even foreign lands. It is interesting to find that the proportion of migrants from the community among the students registered in the years 1919 to 1938 is almost identical with the proportion among those of the period 1824 to 1919. Fifty-four per cent of the first group studied had migrated, compared with forty-nine per cent of the more recent students.

A good deal of Miss Hoag's study was devoted to an analysis of the distance of migration and the size of the community lived in. There has been little change in this distribution when the two studies are compared. She classified her sample by the size of the community in or near which the former students resided, so that the number living on farms is not known. She found that 47 per cent were living in or near centers of 5000 or more. In the present study it was found that only 19 per cent were living in centers of 2500 or more. Some of the difference may be due to her classification of the place of residence by the post office from which mail was received, but it seems doubtful that all the difference could be attributed to this fact. Of course, a larger proportion of the present sample will eventually go to urban areas. However, this difference may indicate a lessening of urbanward migration from this community.

Comparison of distance of migration is given in the table below. It will be seen that the more recent group tends to show a slightly more limited range of migration, which may be attributable to a larger proportion of adolescents among them.

TABLE 1. DISTANCE OF MIGRATION OF FORMER STUDENTS ATTENDING UNION ACADEMY BETWEEN 1824 AND 1919, COMPARED WITH THOSE ATTENDING BETWEEN 1919 AND 1938

	Hoag sample 1824–1919*	Present study 1919–1938
	Per cent	*Per cent*
In foreign countries	2	0
In United States outside New York State	17	6
In New York State outside Jefferson County	15	21
In Jefferson County outside community or district	20	26
Still in the community	46	47
Total	100	100

*See footnote 4, page 4.

In both groups, about half of the students have left the district, and half have remained. What are the differences between these two groups? They are analyzed in this section for the factors of age, sex, achievement in school, number of years of schooling, whether farm- or village-reared, and for certain factors in the parental home.

AGE IN RELATION TO PRESENT PLACE OF RESIDENCE

Writers on rural life frequently comment on the fact that the community is being bled by the city of its brightest manhood and womanhood in the vigor of their youth, leaving the dependent young and old in the rural areas to be supported by a smaller proportion of productive workers. This study cannot contribute much information on this matter of age selection in migration for two reasons: first, because of the nature of the sample. The age range is limited by the fact that it was chosen to cover only a time section (19 years) of the students who have attended Union Academy. In fact, the whole group covered by this study might well be regarded as young people. Their average age at the present time is 25 and the range is from 15 to 37. Secondly, the ages at which the now older migrants left are not known. This question was omitted from the questionnaire for the sake of brevity. Migrants and non-migrants within a very limited age range are compared, and consequently there is a reversal of the generalization made by most investigators of this problem.

These data are most useful, however, in indicating what changes may be expected in the migrations of the group now in the community as they grow older. The proportions from the older age groups which have migrated may be some measure of what can be expected for the younger portion of the sample.

The analysis of the age factor in relation to these migrants and non-migrants is also interesting in view of the theory frequently advanced in connection with youth studies that the young people of rural communities are no longer leaving those communities, because of the curtailment of opportunities elsewhere.

In table 2 is shown a pronounced difference in age between those who are still in the area and those who left. Half of the migrants are over 25, whereas only 43 per cent of the tota sample are in that age group. Six of each ten of those under 21 are still in the district. The older they are the more likely they are to be outside the district. As these former students grow older more of them will leave the district. Thus it would appear that when it is said that the district now has about 50 per cent of those it educates, it must be recognized that they are not all in their most productive years. At any time there will be 50 per cent of the former students of the school resident in the district, but that will always include a large number just out of school, who will eventually migrate.

If this particular group were resurveyed ten years from now the majority would be close to the peak of their productive years, and a considerable difference would be found in the proportions of migrants.

Estimates were made on the basis of the figures in table 2 for the probable situation ten years from now. The group now 15 to 17 years of age will be 25 to 27, and accordingly 47.3 per cent, or 10 of them, will be gone. The same proportion of the group now 18 to 20 will then be gone, or 29 persons. Sixty-nine per cent of the group now 21 to 25 will be gone, or 73 persons. Two-thirds of those now 26 to 30 will be gone, or 61 of that group. Although the increases for the two oldest groups cannot be estimated, a total of 209 of the students now out of school will be gone. Since 70 per cent of those in the older-age groups who have gone away to school have left, 11 more should be added to the 209 to get the total number who will be gone 10 years from now. This gives a total of 220 migrants, or 66 per cent. Therefore the district stands to lose many more of this group of former students.

By comparing the size of the communities lived in at the present time by the various age groups it is possible to obtain some idea of where these

TABLE 2. Age of Former Students in Relation to Present Location within or outside the School District

Present age in years	Present location			
		Not in school		Away at school
	Total	In the district	Outside the district	Parents in the district
	Number	*Number*	*Number*	*Number*
Total	331	156	158	17
15–17	22	13	4	5
18–20	62	36	20	6
21–25	104	43	55	6
26–30	91	48	43	0
31–35	49	15	34	0
36–37	3	1	2	0
	Distribution of present location by age classes			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
15–17	7	8	3	29
18–20	19	23	13	35
21–25	30	28	34	36
26–30	28	30	27	0
31–35	15	10	22	0
36–37	1	1	1	0
	Distribution of age classes by present location			
Total or average	100	47	48	5
15–17	100	59	18	23
18–20	100	58	32	10
21–25	100	41	53	6
26–30	100	53	47	0
31–35	100	31	69	0
36–37	100	*	*	*

*Numbers too small to figure percentages on them.

younger folks who are likely to leave the community will go. It can be seen from table 3 that more of the younger individuals reside in rural areas and more of the older ones in cities. Fifty-eight per cent of those residing in cities are over 25, but only 43 per cent of the whole sample are over 25. Furthermore 31 per cent of those residing in rural areas are under 21, but only 8 per cent of those in cities are under 21.

This tendency for the older migrants to live in larger centers suggests that if complete data had been obtained on their moves from place to place, support might have been found for the theory that migration proceeds outward from an area in wavelike movements. These younger people who are still in smaller centers may through subsequent moves finally reach the city.

The association between age and present location suggests that more of this sample will be residents of cities ten years from now than at the present time. It is estimated that ten years from now 25 to 30 per cent of these former students will be city dwellers, instead of 19 per cent as at the present time, assuming no fundamental change in general conditions in that period.

TABLE 3. AGE IN RELATION TO PRESENT LOCATION OF FORMER STUDENTS ON FARMS, IN VILLAGES AND IN NON-FARM HOMES, OR IN URBAN AREAS

Present age	Total	Present location				
		On farms	In villages and non-farm homes	Total in rural areas	In cities	In the army or navy
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Total........	317	139	110	249	59	9
15–17............	21	11	8	19	2	0
18–20............	62	39	19	58	3	1
21–25............	97	41	31	72	20	5
26–30............	87	31	36	67	20	0
31–35............	47	15	15	30	14	3
36–37............	3	2	1	3	0	0
	Distribution of place of residence by age classes					
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total........	100	100	100	100	100	100
15–17............	7	8	7	8	3	0
18–20............	20	28	17	23	5	*
21–25............	30	30	28	29	34	*
26–30............	27	22	33	27	34	0
31–35............	15	11	14	12	24	*
36–37............	1	1	1	1	0	0
	Distribution of age classes by place of residence					
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average.....	100	43	35	79	19	3
15–17............	100	52	38	91	10	0
18–20............	100	62	31	94	5	2
21–25............	100	42	32	74	21	5
26–30............	100	36	41	77	23	0
31–35............	100	32	32	64	30	6
36–37............	100	67	33	100	0	0

*Numbers too small to figure percentages on them.

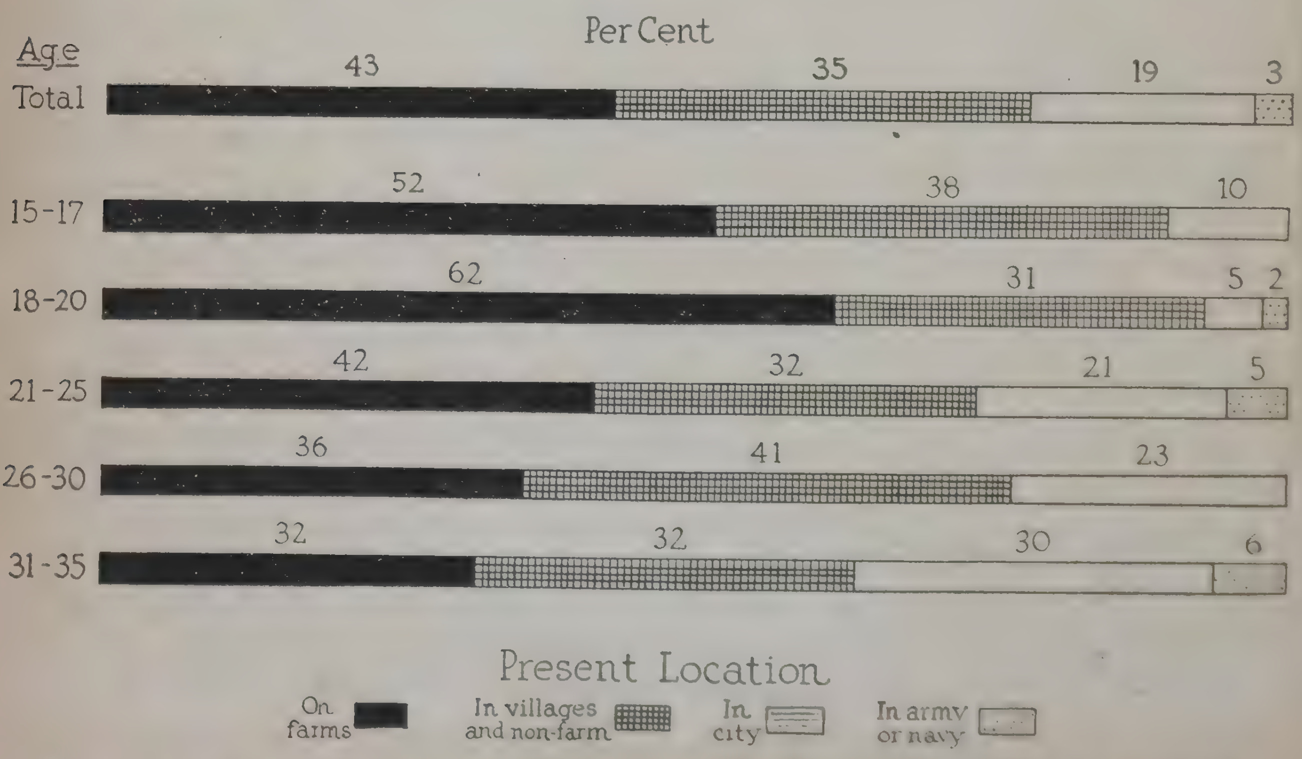

FIGURE 2. RELATION OF AGE OF FORMER STUDENTS TO PRESENT PLACE OF RESIDENCE

To carry the analysis further, rural residents are classed in two groups: those on farms and those in villages and in non-farm residences. In table 3 it is shown that the farms have the largest proportions from the younger age groups. Only 34 per cent of these former students who are on farms are over 25, and 38 per cent of those in villages, whereas 58 per cent of those in urban areas are in that group. Thirty-six per cent of those on farms are under 21, and 25 per cent of those in villages, but only eight per cent of those in cities are under 21.

In summary, age is a factor to some extent associated with migration of these former students of Union Academy. It is related to movement from the district, and from this rural area to cities. It is evident that this study can be regarded only as a cross-section in time. It is representative of the situation of the district for any similar period of time. It is certain that the migration described above does not indicate the total migration which this particular group of students will make.

SEX IN RELATION TO PRESENT PLACE OF RESIDENCE

It was one of the classic laws of migration formulated by Ravenstein that "females are more migratory than males".[7] Many studies of rural-urban migration indicate that a considerably larger proportion of females than of males leave the farms and rural areas for the city. Cities furnish increasing vocational opportunities for women. The rural areas offer little opportunity for economic independence or vocational achievement to young women, aside from teaching school.

Some features of this sample need to be pointed out before discussing the data on the subject of sex selection. Information for all individuals was obtained on the factor of sex. However, because information on the size of the community lived in at present is not known for 27 persons, the sample is cut down somewhat in the tables on distribution according to the size of present place of residence.

TABLE 4. SEX OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION WITHIN OR OUTSIDE THE SCHOOL DISTRICT

Sex	Total	Present location		
		Not in school		Away at school
		In the district	Outside the district	Parents in district
	Number	*Number*	*Number*	*Number*
Total	339	156	166	17
Male	152	77	67	8
Female	187	79	99	9
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Male	45	49	40	47
Female	55	51	60	53
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	46	49	5
Male	100	51	44	5
Female	100	42	53	5

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[7] Ravenstein, E. G. The laws of migration. Royal Statis. Soc. Journ. **48**: 167–235. 1885.

It will be seen upon reference to table 4 that there are eleven per cent more females than males in this group of former students. Attendance at high school in this rural area has apparently been somewhat more a privilege of the girls than of the boys because a check of census figures for 1930 shows a preponderance of males in the county, in the age groups which would have contributed to the high-school group. There seems little reason to believe that this particular area should be strikingly different from the other sections of the county in its sex ratio, and it must have as many or more males than females. It must be reasoned, therefore, that high-school attendance for one year or more operates as a sex-selective factor in this rural high school.

This picture is not changing, since a tally reveals that all of the last five classes entering had a small preponderance of females. One possible explanation is that farm boys who finish eight grades are past the age of compulsory attendance and drop out of school without entering high school. Also more of the boys who entered high school at 15 dropped out of school when they became 16 without finishing the year. The girl feels she needs high school more for preparation for the vocation she will enter, whereas the boy who is learning his vocation by working with his father on the home farm, may feel that further schooling will not help him. Or, again, it may not be a volitional matter, but rather that the boy must leave school as soon as the law allows because he is needed on the farm.

As a result of this preponderance of females in the sample, they comprise a larger proportion than do the males both of those still in the community and of those who have left. However, nineteen per cent more of those who have left are females, compared with only one per cent more females among those still in the district. Stated another way, nine per cent more of the girls than of the boys have left the district.

Do the female migrants go to other rural areas or migrate to the cities? Data on rural and urban residence in relation to the factor of sex are given in table 5. The proportion of females among those resident in cities exceeds the proportion of males by 33 per cent, but among those resident in rural areas, the proportion of females exceeds the proportion of males by only 7 per cent. Nine per cent more of the females than of the males are now resident in cities.

Grouping the rural residents into farm, and village and non-farm, gives an interesting reversal of proportions (table 6). For the first time one of the categories shows a preponderance of males, and that is among the farm residents. Eleven per cent more of those on farms are males. The greatest difference in the proportions of the sexes is found among the village and non-farm residents. There the females exceed the males by almost thirty per cent. Seventeen per cent more of the boys than of the girls reside on farms, but fourteen per cent more of the girls reside in villages or in non-farm residences, and nine per cent more of the girls than of the boys are in cities.

A special tally shows that the preponderance of males on farms is due to the preponderance of males among those who have remained on farms in the district. When those on farms in the district are compared with those on farms outside the district it is found that men and women have moved in equal numbers to farms outside, but that larger numbers of the women than of the men have left the farms in this district. The farms of

TABLE 5. SEX OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION IN RURAL OR URBAN AREAS

Sex	Total	Present location		
		In rural areas	In cities	In army or navy
	Number	*Number*	*Number*	*Number*
Total	324	253	62	9
Male	147	117	21	9
Female	177	136	41	0
	Distribution of present location by sexes			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Male	45	46	34	100
Female	55	54	66	0
	Distribution of sexes by present location			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	78	19	3
Male	100	80*	14*	6
Female	100	77*	23*	0

*These percentages are not directly comparable because of the 6 per cent of males in the army and navy. However, if this is eliminated the percentage of males in cities would be 15 and in rural areas 85. So far as migration is concerned, members of the army and navy may legitimately be classed with those in cities, in contrast to those in rural areas.

TABLE 6. SEX OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION ON FARMS, IN VILLAGES AND IN NON-FARM HOMES, OR IN URBAN AREAS

Sex	Total	Present location			
		On farms	In villages and in non-farm homes	In cities	In the army or navy
	Number	*Number*	*Number*	*Number*	*Number*
Total	324	139	114	62	9
Male	147	77	40	21	9
Female	177	62	74	41	0
	Distribution of present location by sexes				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	110	100	100	100
Male	45	55	35	34	100
Female	55	45	65	66	0
	Distribution of sexes by present location				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	43	35	19	3
Male	100	53	27	14	6
Female	100	35	42	23	0

the district sent more girls than boys to high school, but of the former students now residing on farms many more are men. Fifty-seven of a hundred former students now resident on farms in the district are males, but only forty-three of a hundred students resident on farms at the time of attending high school were males.

Almost all investigators find that males migrate greater distances than do females. The distance of migration from the school district in relation to sex is shown in table 7. These data support the findings of other investigators so far as movement outside the State is concerned. Males exceed females by fifty-five per cent among those who have left the State. This difference in proportion is reversed in the case of the group resident in other parts of Jefferson County outside the adjacent townships. The preponderance of females in this case is accounted for by their number in the city of Watertown, the county seat.

TABLE 7. SEX OF FORMER STUDENTS IN RELATION TO THE DISTANCE FROM THE SCHOOL DISTRICT OF THEIR PRESENT LOCATION

Sex	Total	Distance from the district					
		In the school district	In adjacent townships	Elsewhere in Jefferson County	In adjacent counties	Elsewhere in New York State	Elsewhere in the United States
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Total	325	173	38	36	18	42	18
Male	147	85	21	8	4	15	14
Female	178	88	17	28	14	27	4
	Distribution of distance from the district by sexes						
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100	100	100
Male	45	49	55	22	22	36	78
Female	55	51	45	78	78	64	22
	Distribution of sexes by distance from the district						
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	52	12	11	6	13	6
Male	100	58	14	5	3	10	10
Female	100	49	10	16	8	15	2

It is evident from these data that there are sex differences in distance of migration. More of the women have migrated greater distances from the district until state boundaries are reached, but beyond that the men predominate among the migrants.

In summary of this section on sex as a factor in migration, using migrant and non-migrant for comparison, it can be said:

1. There are 11 per cent more women than men in this group of former high-school students.
2. Nine per cent more of the women than of the men have migrated from the district and are not now in school.

3. Nine per cent more of the women than of the men have migrated to cities.
4. A much smaller proportion of the women than of the men are on farms. It is true, of course, that a slightly larger proportion of the men than of the women lived on farms while going to high school, but the difference was not nearly as great as between the proportions of the two sexes now residing on farms, which is 17 per cent.
5. The proportion of these women students now living in villages or in non-farm residences exceeds the proportion of males residing there by 15 per cent.
6. A larger proportion of the women students have migrated from the county but a larger proportion of the men have gone outside the State.

ACHIEVEMENT IN SCHOOL WORK IN RELATION TO MIGRATION

One of the primary purposes of this study is to test the hypothesis that rural-urban migration is increasing the proportion of the less mentally able in the rural population because the city attracts the most capable rural young people. Various measures have been used in comparing the ability of migrants and non-migrants. Gist and Clark used the results of Terman Intelligence Tests taken in rural high schools.[8] Otto Klineberg used an average of school grades at elementary level.[9] Mueller, in his study of migrants from villages in Germany, used the grades in the three subjects which all students were required to take.[10] Almost all studies compare migrants with non-migrants on the basis of the number of years of schooling they have had. Occupations followed by migrants and non-migrants are widely used as indicators of mental ability.

In this study grades achieved in high school have been used as indicators of certain qualities, attitudes, and achievements, the decrease of which in any great degree impoverishes a community.

It is recognized that school achievement cannot be safely used as a measure of "intelligence", if the latter implies innate mental ability. Furthermore, it is recognized that bookish and docile pupils tend to favor formal school studies and to go into vocations for which their scholastic accomplishments qualify them. It is also true that formal schooling is an index of social and economic factors as well as aptitude for education, which factors have not been associated in this study except as indicated by the schooling of the parents.[11] In spite of these qualifications it is true that there is a considerable mass of evidence, not however undisputed, that amount of schooling and achievement in school studies are related to achievement in later life, and that scholastic ability is, by and large, as good an index of mental ability as has yet been found. It may well be that a different type of mental ability and other personality characteristics are more essential for farming than for the occupations in which scholastic ability is important. Ratings of scholastic ability have been developed to measure the latter rather than the former. It is possible that those superior scholastically might not make as successful farmers as do those with lower school grades but who are superior in other characteristics essential for agriculture; but this is a hypothesis which requires verification.

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[8] Gist, Noel P., and Clark, Carroll D. Intelligence as a selective factor in rural-urban migrations. Amer. journ. soc. **44**: 36–58. 1938.

Professor Gist writes that he and his collaborators, Pihlblad and Gregory, have collected data on approximately 5000 former high-school students with their grades and movement and occupational choice. He advises that the scholastic index of former high-school students who migrated to urban communities is significantly higher than the index for individuals who are now living on farms. The sample representing rural-non-farm communities has a higher index than that of the farm group but is slightly lower than for the urban group. He expects to publish a report on these data shortly.

[9] Klineberg, Otto. The intelligence of migrants. Amer. soc. rev. **3**:218–224. 1936.

[10] Mueller, Josef. Siebungvorgange bei der abwanderung vom dorfe. Archiv fur Bevolkerungswissenschaft (Volkskunde) und Bevolkerungspolitik $\mathbf{7}^1$:33–54. 1937.

[11] Selective character in American education, by George G. Counts. 1922.

For the ideas embodied in this paragraph the author is indebted to Dr. Thomas L. Bayne of the Department of Rural Education, Cornell University.

The section on method explains how the grades achieved in high school were used in locating the students in ranks by fourths. It will be recalled that position in the first, or upper, fourth means greater success, while the lowest fourth indicates low position in relation to fellow classmates.

These ranks by fourths were established for some on the basis of only one year's record while for others grades for four or five years were used, depending upon the period of attendance at the academy.

It will be seen from table 8 that those who have spent fewer years at Union Academy tend to be somewhat less able academically.

This raises the question whether some of the lower ranking is due to change to a new school or actually to less ability. However, a study of the record of these students shows that 40 of them, or less than 10 per cent, enrolled in Union Academy after their freshman year. A check of the average ranks of these students reveals that they have a wide range and several of them do overcome the disadvantage of transfer in the middle of their high-school careers and do obtain better than average ranks.

TABLE 8. NUMBER OF YEARS SPENT AT UNION ACADEMY BY FORMER STUDENTS, IN RELATION TO RANK BY FOURTHS IN CLASS

Rank in fourths of class	Total	Number of years at Union Academy					
		1	2	3	4	5	6
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Total	408	91	68	51	117	77	4
1	100	12	7	17	43	21	0
2	100	14	19	9	34	24	0
3	101	16	14	15	29	24	3
4	107	49	28	10	11	8	1
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100	100	100
1	24	13	10	33	37	27	0
2	25	15	28	18	29	32	0
3	25	18	21	29	25	31	75
4	26	54	41	20	9	10	25

Far more of the short terms of attendance at Union Academy are due to dropping out or removal after starting as freshmen; hence, so far as short terms of attendance at Union Academy are associated with lower grades, little of this can be attributed to mobility.

Class rank and migration from the community

Though low grades do not appear to be related to mobility in the parental household, what of their relation to the migration of the student himself? In table 9 is given the rank distribution of this group of former students on the basis of whether they are still in the district.[12]

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[12] It will be noticed that these fourths are not even. This is due to the fact that no students were eliminated at the time the divisions of the classes into fourths were made. Since then the students still in high school, the deceased, and those who left with their parents have been removed from the sample, with the result that by chance a greater number was taken from the second and fourth fourths than from the first and third.

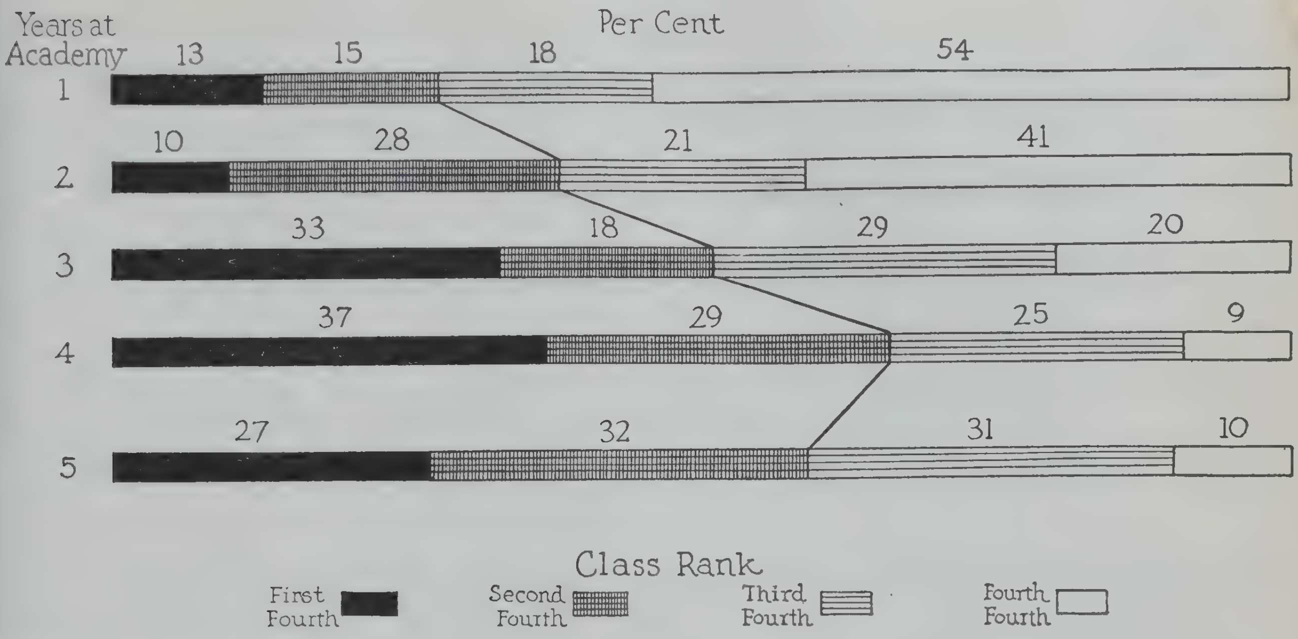

FIGURE 3. PERCENTAGE OF FORMER STUDENTS IN DIFFERENT CLASS RANKS, BY NUMBER OF YEARS IN BELLEVILLE UNION ACADEMY

TABLE 9. RANK BY FOURTHS OF CLASS OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION WITHIN OR OUTSIDE THE SCHOOL DISTRICT

Rank in fourths of class	Total	Present location		
		Not in school		Away at school
		In the district	Outside the district	Parents in district
	Number	*Number*	*Number*	*Number*
Total	339	156	166	17
1	86	35	41	10
2	84	34	46	4
3	87	39	47	1
4	82	48	32	2
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
1	25	22	25	58
2	25	22	28	24
3	26	25	28	6
4	24	31	19	12

The evidence in table 9 seems to indicate a slight trend for more of those with higher class rank to leave the district. The interpretation is complicated by the fact that 17 are now away at school, and they cannot be fairly classed as residing either within or outside the district, for two-thirds of them (see table 19) will leave the district as soon as they finish their schooling, while four-fifths of them rank in the upper half. If they are classed as residing in the district, which is their legal residence, the proportion of those with high grades residing in the district is unduly raised. Therefore those away at school are classed as two-thirds resident outside the district and one-third within, which seems the most equitable manner of taking them into consideration. When this is done, the upper and lower halves by class rank are distributed as to residence as shown in table

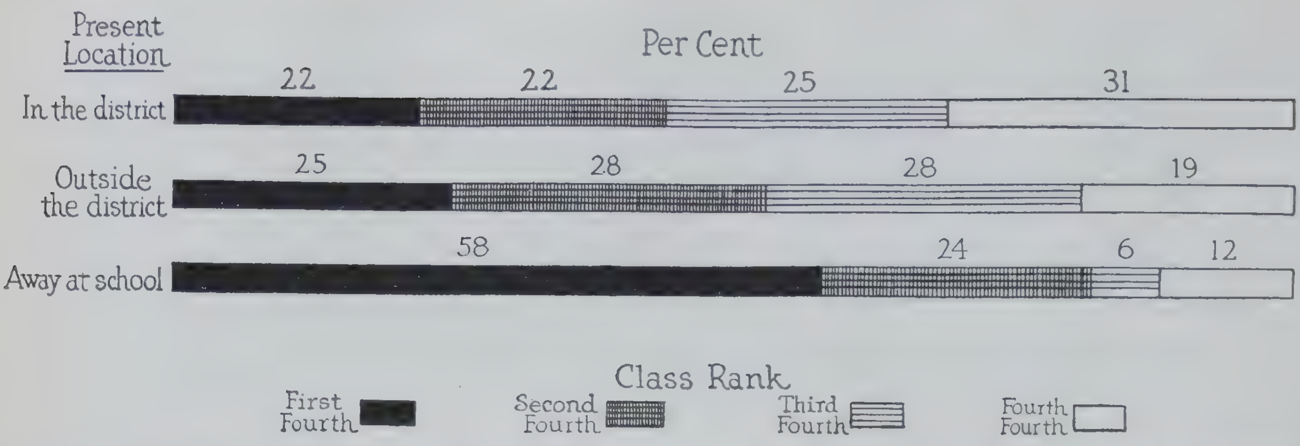

FIGURE 4. PERCENTAGE OF FORMER STUDENTS IN DIFFERENT CLASS RANKS, BY PRESENT PLACE OF RESIDENCE INSIDE OR OUTSIDE THE DISTRICT

TABLE 10. RANK OF FORMER STUDENTS IN UPPER AND LOWER HALVES IN RELATION TO PRESENT LOCATION WITHIN OR OUTSIDE THE SCHOOL DISTRICT, ADJUSTED FOR THOSE AWAY AT SCHOOL*

Class rank	Total	Present location	
		In the district	Outside the district
	Number	*Number*	*Number*
Total	339	161	178
Upper half	170	73	97
Lower half	169	88	81
	Per cent	*Per cent*	*Per cent*
Total	100	100	100
Upper half	50	45	54
Lower half	50	55	46

*Coefficient of association =0.11

10. This indicates a very slight degree of association between rank and present place of residence.

It has been shown (table 8) that many of those who do not complete high school are in the lower half of their class rank, and that those who complete four years of high school, or more, have the higher ranks and are more likely to leave the community. This raised the question as to whether those who drop out of high school might show more tendency to remain in the district and thus account for more of the students with lower class rank to be found in the district. These relations were tabulated and are given in tables 11 and 12, which include only the 339 students who did not migrate with their parents. Table 12 was computed by classing those away at school with those residing within and outside the district, as was done in table 10. These tables show clearly that of those who remain in high school only one to three years a larger proportion of those with low grades tend to remain in the district. Taking them as a total (158 in number), there is a coefficient of association of 0.31 between residence in the district and lower class rank, as compared with residence outside the district and higher class rank.

On the other hand, those who complete four years of high school and go no further are much less likely to show this trend, the coefficient of association being only 0.20 (though this may be due to chance); while those

TABLE 11. RELATION OF YEARS IN HIGH SCHOOL AND SCHOOLING BEYOND HIGH SCHOOL TO CLASS RANK AND PRESENT RESIDENCE INSIDE OR OUTSIDE THE DISTRICT

Class rank in fourths	Years in high school															College or trade school		
	One year only			Two years only			Three years only			Total less than four years			Four years only					
	Inside district	Outside district	Away at school	Inside district	Outside district	Away at school	Inside district	Outside district	Away at school	Inside district	Outside district	Away at school	Inside district	Outside district	Away at school	Inside district	Outside district	Away at school
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
1	3	6	0	2	4	0	3	7	3	8	17	3	19	10	3	8	13	4
2	4	5	0	4	11	1	2	5	0	10	21	1	19	18	2	3	5	1
3	2	7	0	3	8	0	6	8	0	11	23	0	22	14	1	3	6	0
4	21	13	0	11	11	0	3	4	1	35	28	1	10	3	1	2	0	0
Total	30	31	0	20	34	1	14	24	4	64	89	5	70	45	7	16	24	5
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1	10	19	0	10	12	0	21	29	75	12	19	60	27	22	43	50	54	80
2	13	16	0	20	32	0	14	21	0	16	24	20	27	40	29	19	21	20
3	7	23	0	15	24	0	43	33	0	17	26	0	31	31	14	19	25	0
4	70	42	0	55	32	0	21	17	25	55	31	20	14	7	14	12	0	0
Total	100	100	0	100	100	0	100	100	100	100	100	100	100	100	100	100	100	100

TABLE 12. RELATION OF YEARS IN HIGH SCHOOL AND SCHOOLING BEYOND HIGH SCHOOL TO CLASS RANK AND PRESENT RESIDENCE INSIDE OR OUTSIDE THE DISTRICT, CORRECTED BY ALLOCATING THOSE AWAY AT SCHOOL TO RESIDENCE WITHIN OR OUTSIDE THE DISTRICT

Class rank	Years in high school										College or trade school	
	One year only		Two years only		Three years only		Total less than four years		Four years only			
	Inside district	Outside district	Inside district	Outside district	Inside district	Outside district	Inside district	Outside district	Inside district	Outside district	Inside district	Outside district
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Upper half........	7	11	6	16	6	14	19	41	39	32	9	22
Lower half........	23	20	14	19	9	13	46	52	33	18	5	6
Total	30	31	20	34	15	27	65	93	72	50	16	28
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Upper half........	23	35	30	46	40	52	29	44	51	64	57	78
Lower half........	77	65	70	54	60	48	71	56	49	36	43	22
Total	100	100	100	100	100	100	100	100	100	100	100	100
Coefficient of association......	0.287		0.32		0.235		0.31		0.20		0.34	

who go on to colleges or other schools beyond high school have a very definite trend for the best students to leave the district, the coefficient of association being 0.34. Thus it may be safely concluded that those who drop out of high school (49 per cent of the total) and those who go on to college or other schools (14 per cent), have a definite tendency to leave the district if they are in the upper halves of their classes. It should be noted that these two classes form 63 per cent of the total sample, or nearly two-thirds. On the other hand, among those who complete high school and go no further, there is much less difference between the grades of those who remain in the district and those who leave it.

Thus the district appears to be losing slightly more of its more able youth, as measured by achievement in school, than it is keeping.

However, as it was interesting to speculate on the extent of future migration from this group, using the data on the older age groups as a basis for estimates, it is doubly interesting to make similar estimates, on the extent of selectivity on the basis of mental ability (as indicated by

TABLE 13. CLASS RANKS OF FORMER STUDENTS IN RELATION TO LOCATION WITHIN OR OUTSIDE THE DISTRICT, BY AGE GROUPS

Class ranks	Total	Present location		
		In the district	Outside the district	Away at school
	Number	*Number*	*Number*	*Number*
Under 21:				
Total	84	49	24	11
Upper half	38	23	7	8
Lower half	46	26	17	3
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Upper half	45	47	29	73
Lower half	55	53	71	27
Total or average	100	58	29	13
Upper half	100	61	18	21
Lower half	100	56	37	7
	Number	*Number*	*Number*	*Number*
21–25:				
Total	104	43	55	6
Upper half	58	21	31	6
Lower half	46	22	24	0
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Upper half	56	49	56	100
Lower half	44	51	44	0
Total or average	100	41	53	6
Upper half	100	36	54	10
Lower half	100	48	52	0
	Number	*Number*	*Number*	*Number*
26 and over:				
Total	143	64	79	0
Upper half	71	25	46	0
Lower half	72	39	33	0
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	0
Upper half	50	39	58	0
Lower half	50	61	42	0
Total or average	100	45	55	0
Upper half	100	35	65	0
Lower half	100	54	46	0

school grades) in the future migrations. It was found that for those now 26 years of age and over, 65 per cent of those who were in the upper halves of their classes when in school have migrated (table 13). On the other hand, only 46 per cent of the lower-half members of this age group have left.

It may be that this factor continues to increase in effect even after 26, and more than 65 per cent of the upper level of the group now 26 and over, which is actually a range of 26 to 38, may be migrants by the time they are 36 to 48 (ten years from now). Therefore, it may be that to make an estimate for the next ten years of the effect of the factor of ability as a selector of migrants, the proportion from the upper rank who will have migrated from the group now 26 to 30 should be increased. However, if it is assumed that the porportions will remain the same for the group now 26 and over, and that the younger group will be affected by the operation of this factor as the older has, it can be said that ten years hence, 65 per cent of those who were in the upper halves of their classes will have migrated, as compared with only 46 per cent of those from the lower halves. Stated conversely, only 35 per cent of the more able will still be in the district, and 54 per cent of the less able will still be there.

Location with reference to rural and urban areas

The data given above apply only to differences between those still resident in this school district and those who have moved from it. This study has not furnished data for testing the hypothesis that rural-urban migration results in a loss of the better elements in the rural population, because not all who have left the district have also left the farm or the rural areas. Comparison between the former students who are now resident in rural areas and those in cities is given in table 14.

TABLE 14. CLASS RANKS, BY FOURTHS, OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION IN RURAL OR URBAN AREAS

Rank in fourths of class	Total	Present location		
		In rural areas	In cities	In army or navy
	Number	*Number*	*Number*	*Number*
Total	320	253	62	5
1	84	64	19	1
1	80	59	20	1
3	81	62	17	2
4	75	68	6	1
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
1	27	25	31	*
2	25	23	32	*
3	25	25	27	*
4	23	27	10	*

*Numbers too small to figure percentages on them.

The most striking difference in proportions is in the lowest fourth. Twenty-seven per cent of those now in rural areas were in the lowest fourth while in school, but only ten per cent of those now in cities were from this level. There is a difference of only 5 per cent between the two groups in the proportions from the first fourth in favor of cities. It should

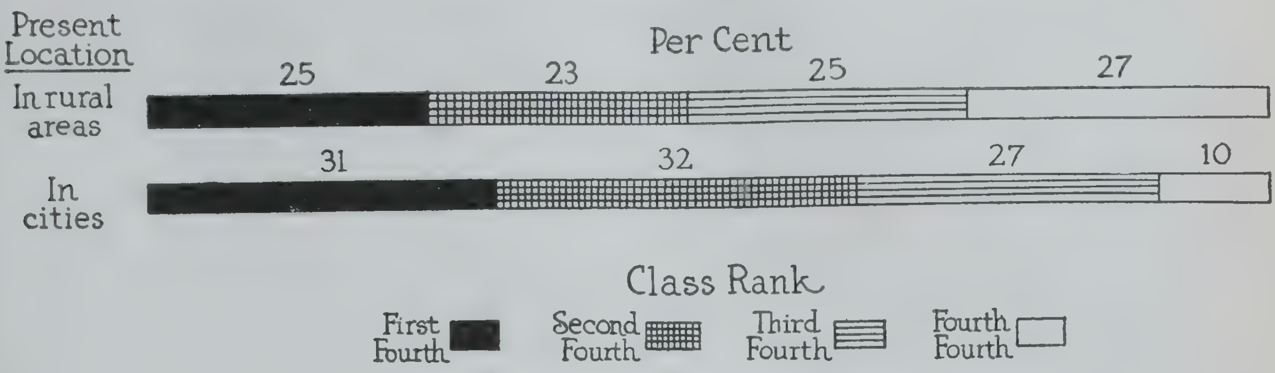

FIGURE 5. PERCENTAGE OF FORMER STUDENTS IN DIFFERENT CLASS RANKS, BY PRESENT PLACE OF RESIDENCE IN RURAL AREAS OR CITIES

be pointed out also that the group labeled "away at school" in the previous table has been included among the residents of rural areas in this table, tending therefore to raise the proportion from the upper levels.

There are apparently greater differences between those in rural areas and those in cities than between those who have left this school district and those still in it. This indicates that among those who are going out from the district an additional selective process is going on sorting out those who go to other rural areas. Taking the sample as a whole, other rural areas are getting only slightly more of the better students than are staying in the district itself, and the city is getting considerably more.

Location with reference to farm, village, and city

In discussing rural territory, farm, non-farm and village have been included therein. Does this classification obscure what is happening with regard to the farm population itself?

If the students classified as residing in rural areas are separated into the two classes (farm, and village and non-farm), the distributions shown in table 15 result. There are only nine non-farm residents in this group; that is, those living in the open-country but not on a farm.

TABLE 15. CLASS RANKS, BY FOURTHS, OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION ON FARMS, IN VILLAGES AND IN NON-FARM HOMES, OR IN URBAN AREAS

Rank in fourths of class	Total	Present location			
		On farms	In villages and non-farm homes	In cities	In army or navy
	Number	*Number*	*Number*	*Number*	*Number*
Total	320	139	114	62	5
1	84	31	33	19	1
2	80	34	25	20	1
3	81	33	29	17	2
4	75	41	27	6	1
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100
1	27	22	28	31	*
2	25	25	22	32	*
3	25	24	26	27	*
4	23	29	24	10	*

*Numbers too small to figure percentages on them.

It is seen that the farm residents include a larger proportion of former students who have not done so well in school than do the residents of the village or of the city. The smallest proportion of those on farms is from the top fourth, and the largest proportion, from the lowest fourth. The village has a larger proportion than the farm from the upper fourth. On the other hand the city has about the same proportions of all the fourths except the lowest, and its proportion of that fourth is only one-third of that for the farms. Of 100 who were in the first fourth, 31 are now in cities, but only 10 of 100 from the lowest fourth are in cities. On the other hand, 22 of 100 students of the top fourth are on farms and 29 of 100 from the lower fourth are on farms.

This completes the analysis of the relation of class rank in school to present place of residence. In summary these data show:

1. That the school district is losing slightly more of its more able students, as measured by school grades, than it is keeping. It is still retaining a large proportion of the able students, but a larger proportion of its less able.
2. When present place of residence is considered in terms of rural and urban differences, rank in school grades seems to be a significant factor. Here the greatest differences are found in the distribution of the lowest-ranking students. Though the lower-ranking students are moving out of this school district in nearly the same proportions as are the better students, they are not moving out of rural areas to the same extent that better students are. The selectivity appears to be of the less able by the rural areas, rather than of the more able by the city. The number of the more able who are away at school makes the distribution of these upper-fourth groups less clear than that of the lower groups.
3. The farm population, as compared with that of the village and the city, has somewhat fewer of the highest rank, and has somewhat more than the village and considerably more than the city of those from the lowest group.

YEARS OF SCHOOLING IN RELATION TO PRESENT PLACE OF RESIDENCE

One of the most widely-used measures for comparing migrants and non-migrants is the number of years of schooling they have had.

For this group of former students, the number of years of schooling completed and the class rank achieved are closely related. This is similar to the finding mentioned previously that those who had spent fewer years at Union Academy tended to be in the lower fourths of their classes. This also checks with the numerous studies which show the selectivity of the school on the basis of scholastic ability. Fewer and fewer of those who make low scores on mental tests are found as one moves from elementary school to high school, and through high school to college. This states in another way the correlation between grades and intelligence, for some success in making grades is essential to remaining in school.

It is seen from table 16 that only nine per cent of those who do not finish high school are in the top fourth, but somewhat more than half of those who do not finish are in the bottom fourth, and three of four of them are in the lower half of their classes.

TABLE 16. SCHOOL RANKS OF FORMER STUDENTS IN RELATION TO SCHOOLING COMPLETED

Rank in fourths of class	Total	Schooling completed				
		Some high school	Four years of high school	Some college	College graduate	Trade school
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Total	337	104	167	35	18	13
1	91	9	45	20	12	5
2	86	16	56	9	3	2
3	80	25	46	4	0	5
4	80	54	20	2	3	1
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100	100
1	27	9	27	57	66	39
2	25	15	33	26	17	15
3	24	24	28	11	0	38
4	24	52	12	6	17	8

On the other hand, 83 per cent of those who graduate from college are from the upper half of their classes. There is a pronounced relation between the number of years spent in school and the grades received. At least this is true up to the completion of high school. But beyond that, economic factors probably also have their effect.

Four-fifths of these former students received no training beyond high school. Another ten per cent received some college training, but only five per cent graduated from college. The others went to trade school, which includes business college, short course in agriculture, or nurse's training. Most of those who went to college were in the top ranks in high school, but not all of them. In other words, high grades are not the only determinant of whether one goes to college; but without good grades there is even less likelihood.

The total students who had four years of high school or less, and those with more than a high-school education, were grouped into those in the upper and lower halves of their classes by rank (as given in table 16). This is shown in table 17.

TABLE 17. RELATION OF RANK IN CLASS TO AMOUNT OF SCHOOLING

Class rank	Attended high school only	College or trade school	Total
	Number	*Number*	*Number*
Upper half	126	51	177
Lower half	145	15	160
Total	271	66	337
	Per cent	*Per cent*	*Per cent*
Upper half	46	77	52
Lower half	54	23	48
Total	100	100	100

The coefficient of association between these two factors of rank and more than high-school training is +0.59, showing a high degree of association between them.

Because of this relationship between class rank and number of years of schooling completed, there is a possibility that similar qualities are measured in these two sections.

Before proceeding to a comparison of migrant with non-migrant on the basis of years of schooling, it should be pointed out that the data for this factor are available for a smaller number of students than in the case of the other factors already discussed. There is a tendency for those for whom these data are lacking to rank mostly in the lower fourths. It therefore follows that because of the relationship between class ranks and years of schooling discussed above, the cases for whom data are lacking have fewer years of schooling. Consequently the tables to follow may present a more favorable picture of the schooling of this group of former students than actually exists.

In table 18 it is shown that a larger proportion of those who left the community than of those who remained had training beyond high school. Nearly one-fourth of the group now out of the community have had training beyond high school, but only about one-eighth of those who are still there have had additional training.

TABLE 18. AMOUNT OF SCHOOLING OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION WITHIN OR OUTSIDE THE SCHOOL DISTRICT

Amount of schooling	Total	Present location		Away at school
		Not in school		Parents in the district
		In the district	Outside the district	
	Number	*Number*	*Number*	*Number*
Total	302	148	137	17
Some high school	93	48	44	1
Four years high school	152	83	60	9
Some college or normal school	30	9	14	7
College or normal-school graduate	15	6	9	0
Trade school	12	2	10	0
	Distribution of present location by amount of schooling			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Some high school	31	32	32	6
Four years high school	50	57	44	53
Some college or normal school	10	6	10	41
College or normal-school graduate	5	4	7	0
Trade school	4	1	7	0
	Distribution of amount of schooling by present location			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	49	45	6
Some high school	100	52	47	1
Four years high school	100	54	40	6
Some college or normal school	100	30	47	23
College or normal-school graduate	100	40	60	0
Trade school	100	17	83	0

Of those who did not go beyond high school, 44 per cent are now outside the district, while 66 per cent of those who went beyond high school have

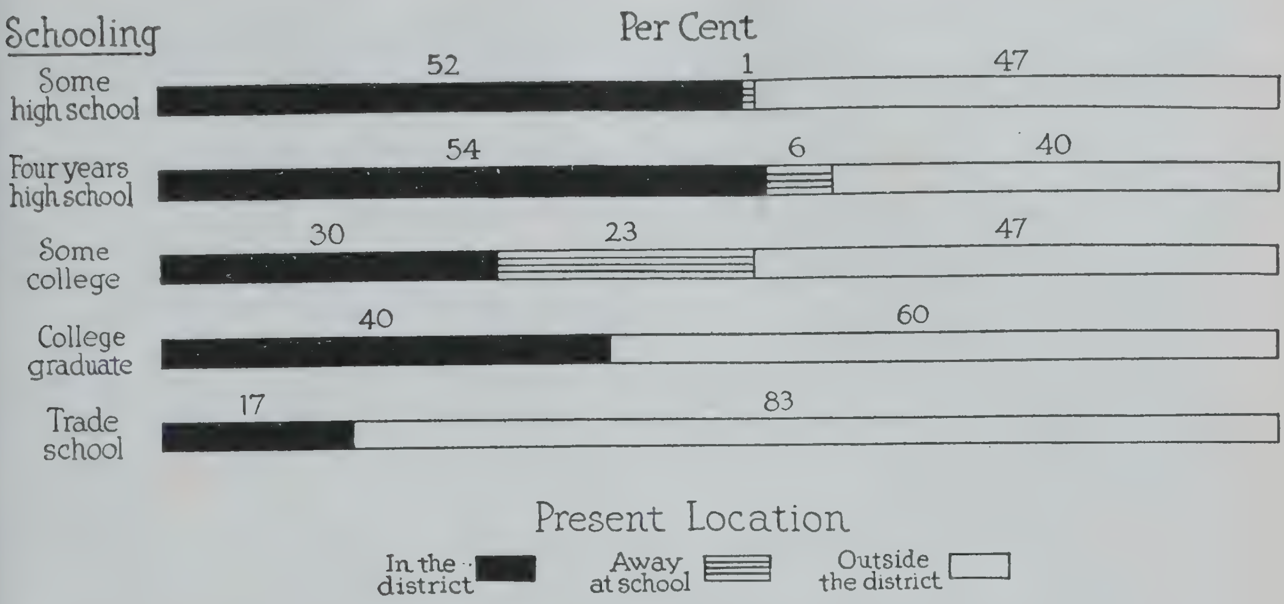

Figure 6. percentage of former students inside or outside the district, by amount of schooling

moved from the district, as shown in table 19. The coefficient of association between the two factors of amount of schooling and present place of residence is +0.42, showing a considerable relationship.

TABLE 19. Relation between Amount of Schooling and Present Place of Residence*

Present place of residence	Attended high school only	College or trade school	Total
	Number	*Number*	*Number*
In the district	131	17	148
Outside the district	104	33	137
Total	235	50	285
	Per cent	*Per cent*	*Per cent*
In the district	56	34	52
Outside the district	44	66	48
Total	100	100	100

*Coefficient of association +0.419

Because of concern over the possible bias introduced by lack of information on some of the cases, estimates were computed for them on the basis of their class ranks; the proportion among the migrants of those with no training beyond high school was increased by three per cent. However, this still leaves a nine-per-cent difference between migrants and non-migrants in the proportions of those with advanced training.

About the same proportions of the two groups, those who have left and those still in the district, have not finished high school. If this were corrected on the basis of estimated distribution of those whose advanced schooling was unknown, the proportion of the migrants who had not finished high school would be increased by three per cent.

It appears that the group who have left represent greater extremes—more who have not finished high school and more who have gone on to college and other schools. The community may be slightly disadvantaged by having a smaller proportion of college-trained residents return to it than leave it permanently.

Only 12 per cent of those now in the community went away for additional schooling, but 24 per cent of those who are now resident elsewhere had additional schooling. If this same sample were studied ten years from now, the proportion with advanced training among those who had left the district would be even greater, for 70 per cent of those now away at school would also be gone. To send its sons and daughters on to school is a rather sure way for this community to lose them.

Turning next to the rural-urban comparisons (table 20), much greater differences are seen than in comparisons between those still in the district and those who have left it. This, it will be recalled, was also true in the analysis by class rank.

TABLE 20. YEARS OF SCHOOLING IN RELATION TO PRESENT LOCATION IN RURAL OR URBAN AREAS

Years of schooling	Total	Present location		
		In rural areas	In cities	In army or navy
	Number	*Number*	*Number*	*Number*
Total	294	232	53	9
Some high school	92	77	12	3
Four years high school	147	120	21	6
Some college or normal school	29	22	7	0
College or normal-school graduate	15	9	6	0
Trade school	11	4	7	0
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Some high school	31	33	23	33
Four years high school	50	51	40	67
Some college or normal school	10	10	13	0
College or normal-school graduate	5	4	11	0
Trade school	4	2	13	0

The proportion of those in rural areas who have not finished high school exceeds by 11 per cent the proportion of this class for those resident in cities. Furthermore 38 per cent of those former students who are now in cities have had training beyond high school, but only 15 per cent of those in rural areas have had such training.

It should also be pointed out that the students who are now away at school are included in the two groups *some college or normal school* and *trade school.* They are also included in *rural residents.* This tends to raise the level for the rural areas and for the district at this particular time, but, as pointed out earlier, the district will eventually lose a large number of them.

It was found in the analysis of the relation of present location and class-rank distribution that the differences between the farm and city were considerably greater than the differences between all rural and city. Likewise, when location and number of years of schooling are related, the differences between farm and city are marked (table 21). A larger proportion of those now on farms than of those in villages or cities have not completed high school. Twenty-four per cent more of those in cities than of those on farms have had training beyond high school.

TABLE 21. Years of Schooling of Former Students in Relation to Present Location on Farms, in Villages and in Non-farm Homes, or in Urban Areas

Years of schooling	Total	Present location			
		On farms	In villages and non-farm homes	In cities	In the army or navy
	Number	*Number*	*Number*	*Number*	*Number*
Total	294	127	105	53	9
Some high school	92	47	30	12	3
Four years high school	147	63	57	21	6
Some college or normal school	29	13	9	7	0
College or normal-school graduate	15	3	6	6	0
Trade school	11	1	3	7	0
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100
Some high school	31	37	29	23	33
Four years high school	50	49	53	40	67
Some college or normal school	10	10	9	13	
College or normal-school graduate	5	3	6	11	
Trade school	4	1	3	13	

It should be pointed out, too, that this group of students represents some selection on the basis of number of years of schooling since only those who finished at least one year of high school were included. All those who dropped out with less than that were eliminated because a satisfactory average grade could not be obtained for them.

One other aspect of analysis of present place of residence in relation to number of years of schooling remains—distance from high school attended. The question is, are those who have had more years of schooling farther removed from the district? Do the county and State, as well as the district, lose more of their better-educated young people than they keep? The answer is readily apparent in table 22. Again it should be mentioned that those away at college are classified as in the district. This tends to swell the proportion of those resident in the district who have had training beyond high school. It must be kept in mind this is not a permanent situation for this sample.

It will be recalled that the adjacent townships drew more of those who ranked in the lower fourths, and it is seen that they also have a larger proportion of those who have not completed high school than has any other area and they have a smaller proportion of those who have had training beyond high school.

The areas outside Jefferson County and the three adjacent counties get the best-educated of this group of former students. Thirty-eight per cent of those there have had training beyond high school. The area outside New York State also attracts a large proportion of the better-schooled, and a few of those who do not finish high school.

In summary of this section on the relationship between the number of school grades completed and present location it appears that years of schooling does not function as a selective factor in migration from this rural district until schooling beyond high school is considered.

It has been seen that about as many of those who moved from the district as of those who remained in it failed to finish high school. However, when considering movement from rural areas to cities, failure to finish high school

TABLE 22. AMOUNT OF SCHOOLING OF FORMER STUDENTS IN RELATION TO THE DISTANCE OF THEIR PRESENT LOCATION FROM THE DISTRICT

Amount of schooling	Total	Present location: In the school district	In adjacent townships	Elsewhere in Jefferson County	In adjacent counties	Elsewhere in New York State	Elsewhere in the United States
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Total	294	165	32	29	16	34	18
Some high school	92	49	15	8	6	9	5
Four years high school	147	92	14	13	8	12	8
Some college or normal school	29	16	1	4	0	7	1
College or normal-school graduate	15	6	0	0	2	3	4
Trade school	11	2	2	4	0	3	0
	Distribution of present location by amount of schooling						
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100	100	100
Some high school	31	30	47	28	38	26	28
Four years high school	49	55	44	44	50	35	44
Some college or normal school	10	10	3	14		21	6
College or normal-school graduate	6	4			12	9	22
Trade school	4	1	6	14		9	
	Distribution of amount of schooling by present location						
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	56	11	10	5	12	6
Some high school	100	53	16	9	7	10	5
Four years high school	100	63	10	9	5	8	5
Some college or normal school	100	56	3	14		24	3
College or normal-school graduate	100	40			13	20	27
Trade school	100	18	18	37		27	

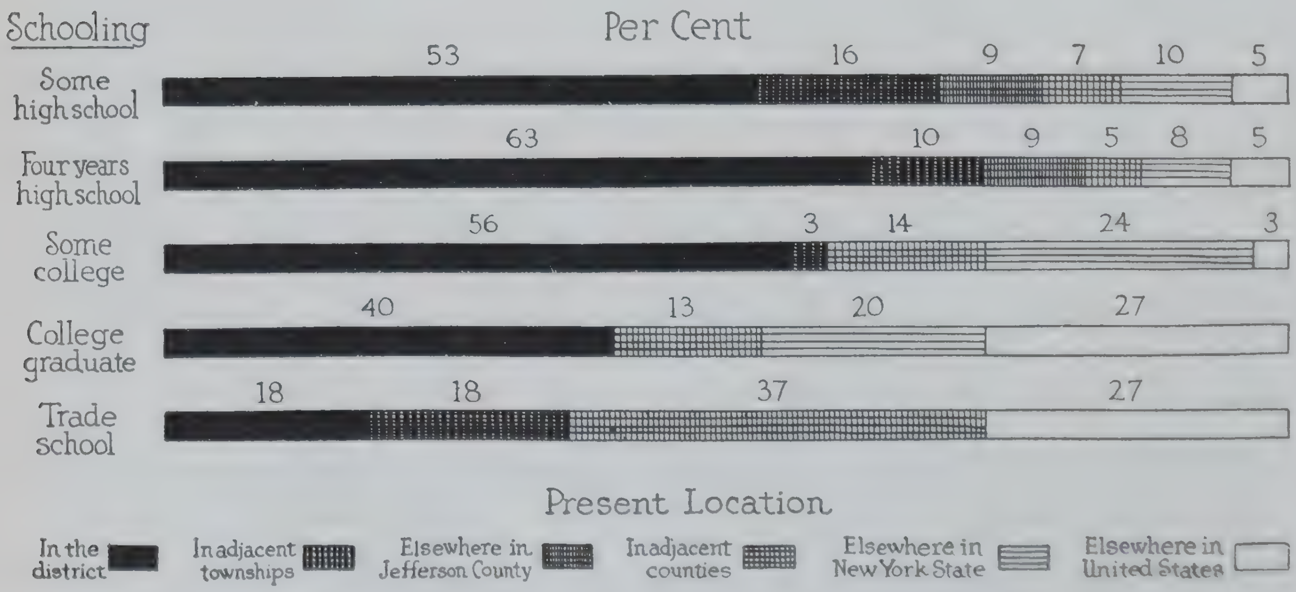

FIGURE 7. PERCENTAGE OF FORMER STUDENTS AT DIFFERENT DISTANCES FROM THE DISTRICT OF PRESENT PLACE OF RESIDENCE, BY AMOUNT OF SCHOOLING

and rural residence seem to be related. Slightly more of those now resident in rural areas (including farm and village residents) than in urban areas fail to finish high school. It cannot be said, however, that these students stay in rural areas because they failed to finish high school. It is possible that having decided to remain on a farm they felt further schooling unnecessary.

There is little doubt, however, that education beyond high school is related to movement from the district, from rural areas, and from the farm. The district has among its share of these students the smallest proportion of those with advanced training. The all-farm has a slightly larger proportion of those with further training—the all-rural a still larger proportion—, and the city much beyond the others. Though to some degree the difference between the district and the other areas may be attributed to the sample, there are still differences important enough to indicate the trend, with the city profiting from the higher education furnished by this community to its sons and daughters. But neither the district nor other rural areas are wholly without their college graduates.

FARM OR VILLAGE RESIDENCE WHILE ATTENDING HIGH SCHOOL, IN RELATION TO MIGRATION

Several studies which have included in their samples both farm and village residents have found the farm population to be less mobile than that of the village. It seemed worthwhile to compare the influence of farm residence at the time of attending high school with that of village and nonfarm residence in the case of this sample. One fact which does not encourage detailed analysis of this factor is the high proportion of these high-

TABLE 23. PLACE OF RESIDENCE OF FORMER STUDENTS WHILE ATTENDING HIGH SCHOOL, IN RELATION TO PRESENT LOCATION WITHIN OR OUTSIDE THE DISTRICT

Place of residence while attending high school	Total	Present location		
		Not in school		Away at school
		Residing in the district	Residing outside the district	Parents still in the district
	Number	*Number*	*Number*	*Number*
Total	333	155	162	16
Village or non-farm	70	24	38	8
Farm	263	131	124	8
	Distribution of present location by place of residence while in high school			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Village or non-farm	21	16	24	50
Farm	79	84	76	50
	Distribution of place of residence while in high school by present location			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	47	48	5
Village or non-farm	100	34	55	11
Farm	100	50	47	3

school students who were farm residents; 80 per cent of them came from farms, and only 20 per cent from village or non-farm homes.

Upon reference to table 23 it is seen that more of those who came from farm homes than of those from village homes remained in the district. Eighty-four per cent of the non-migrants are from farm homes but only seventy-six per cent of the migrants are from such homes.

Only thirty-four per cent of the village-reared students are still in the district, but almost half the farm-reared are still there.

Even though the farm-reared students do not move out of the district in quite such large proportions as do the village- or non-farm-reared, 47 per cent of them have left. Where do they go as compared with village-reared children? Do they go to farms or to cities? In table 24 it is shown that not so many farm-reared as village-reared individuals go into the urban areas. Thirty-six per cent of those now residing in urban areas are from village or non-farm homes, though the sons and daughters from these homes make up only twenty-one per cent of the total sample. Looking at the distribution of the two groups it is seen that the proportion of those who were reared in village and non-farm homes and are now living in cities is twice that of the proportion of farm-reared now living in cities.

TABLE 24. PLACE OF RESIDENCE OF FORMER STUDENTS WHILE ATTENDING HIGH SCHOOL, IN RELATION TO PRESENT LOCATION ON FARMS, IN VILLAGES AND IN NON-FARM HOMES, OR IN URBAN AREAS

Place of residence while attending high school	Total	On farms	In villages and rural non-farm homes	Total in rural areas	In cities	In the army and navy
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Total	319	136	112	248	62	9
Village and non-farm	68	10	35	45	22	1
Farm	251	126	77	203	40	8
	Distribution of present location by place of residence in high school					
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100	100
Village and non-farm	21	7	31	18	36	11
Farm	79	93	69	82	64	89
	Distribution of place of residence in high school by present location					
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	43	35	78	19	3
Village and non-farm	100	15	51	66	32	2
Farm	100	50	31	81	16	3

If, as just shown, farm-reared individuals tend to remain in rural areas even though they may leave their school district, to what extent is this rural settlement limited to farms? By breaking up the group covered by the caption *in rural areas* into farm and village, the proportion of those reared on farms and still resident on farms can be ascertained.

Although 79 per cent of all the students were living on farms at the time they attended high school, only forty-three per cent of them are now resident there. The farms gained 8 per cent from the villages but sent 31 per cent of their boys and girls to the villages. Twenty-one per cent lived in a village or in non-farm residences when they were high-school students, but now thirty-five per cent are living there. The village and non-farm homes lost a small percentage to the farms and much more to the cities, but villages and rural non-farm residences, as a class, more than made up their losses through the movement of farm youth to them. The movement of farm youth from the farms to villages and rural non-farm homes was twice that of the movement to cities. The movement of village-reared youth to cities was twice that of the farm-reared youth to cities.

The proportion of the farm-reared women who are now in cities is almost twice the proportion of farm-reared men there.

TABLE 25. PLACE OF RESIDENCE WHILE ATTENDING HIGH SCHOOL IN RELATION TO PRESENT LOCATION ON FARMS, IN VILLAGES AND IN RURAL NON-FARM HOMES, OR IN URBAN AREAS, BY SEXES

Residence while attending high school	Total		Present location						
			On farms		In villages or rural non-farm homes		In cities		In army or navy
	Males	Females	Males	Females	Males	Females	Males	Females	Males
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Total........	174	201	83	69	54	89	28	43	9
Village or non-farm........	31	47	6	6	13	28	11	13	1
Farm..........	143	154	77	63	41	61	17	30	8
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	100	48	34	31	45	16	21	5
Village or non-farm........	100	100	19	13	42	59	36	28	3
Farm..........	100	100	53	40	29	40	12	20	6

Women exceed farm-reared men in the villages almost as much as in the city. One and one-half times as many of the farm girls as farm men have moved to villages and to rural non-farm homes.

Forty-four per cent of the girls are now resident in villages although only twenty-three per cent of them lived in villages at the time they attended high school. Only thirty-four per cent of the girls now live on farms though 77 per cent of them lived on farms when they were in high school, a decrease of 43 per cent. Forty-eight per cent of the boys now live on farms, whereas eighty-two per cent lived on farms when attending high school, a decrease of thirty-four per cent.

A larger proportion of village-reared men than of village-reared women have made the move to the city, but more farm women than farm men have moved to the city. Village-reared women have stayed in the same type of area more than have any other group. Farm-reared women have changed type of area more than have any other group.

Smaller proportions of farm-reared youth than of village-reared have gone to the cities. Does it follow that they also move shorter distances? The data on this are given in table 26. Half as many of the farm-reared as of the village-reared youth are residing outside the State. Six per cent less of the farm-reared reside outside the county but within the State. A larger proportion of the farm-reared than of the village-reared are in the district and in the adjacent townships. A larger proportion of the village-reared are outside Jefferson County, and also a larger proportion outside New York State.

TABLE 26. PLACE OF RESIDENCE OF FORMER STUDENTS WHILE ATTENDING HIGH SCHOOL, IN RELATION TO DISTANCE OF THEIR PRESENT LOCATION FROM THE DISTRICT

Place of residence while attending high school	Total	Distance from district of present location					
		In school district	In adjacent townships	Elsewhere in Jefferson County	In adjacent counties	Elsewhere in New York State	Elsewhere in United States
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Total	320	171	37	35	18	41	18
Village and non-farm	69	32	6	8	3	13	7
Farm	251	139	31	27	15	28	11
	Distribution of place of residence in high school by present location						
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	2	12	11	6	13	6
Village and non-farm	100	46	9	12	4	19	10
Farm	100	56	12	11	6	11	4

In summary then, it appears that living either on a farm or in a village while attending high school is a factor related to the present place of residence.

1. There are fewer migrants among the farm-reared students than among the village- and non-farm-reared.
2. Those who come from farm homes are considerably more likely to be in rural areas than are those from village- or non-farm homes.
3. Five of ten farm-reared individuals are now living on farms; three of ten are in villages; not quite two of ten are in cities. The remainder are in either the army or the navy.
4. One of ten of the village- or non-farm-reared are on farms; five of ten are in village- and non-farm homes; and more than three of ten are in cities.
5. The proportion of the farm-reared women now in cities is nearly twice that of farm-reared men.
6. Those students who came from farm homes have not, on the average, migrated as great distances as have those reared in village homes. A proportionately smaller number are outside the State, outside the county, and outside the district.

FACTORS IN THE PARENTAL HOME IN RELATION TO PRESENT LOCATION OF FORMER STUDENTS

As various personal factors such as age, sex, and class rank were discussed in preceding sections, the possibility was suggested that certain factors in the parental home might also have had their effect upon the migration of these former students. Information on various factors in the parental home is available from a family schedule for 148 of these former students whose families were resident in the area covered by the field study. This is too small a sample for detailed analysis, but a few factors have been selected.

There is a pronounced difference between the proportion of migrants among the former students whose parents are residing in the area covered by the field study and the proportion among the whole group of one-time students. Only 37 per cent of the first group have left, but 48 per cent of the whole group are gone. It will be recalled that in referring to migrants only those were included who left the community independently of a parental move, so that in the case of those migrants whose parents are now gone from the community, the young people's move preceded that of the parents.

It should be pointed out that the area covered by the field study in which the parental-family schedules were obtained represents only that portion of the school district included in the village and within a three-mile radius of the village. Consequently, in comparing students whose parents are still in the community with the total group of students, those from a restricted area are compared with those from a larger area. This at least leaves open the possibility that the eleven-per-cent difference in migrants may be attributed in some degree to differences within the school district itself. And in view of the quality of the soil and the nature of the agriculture on the western and southern boundaries of the district this hypothesis does not seem untenable.

Number of moves made by head of parental household

Because information on present place of residence of the parents of all students is not available, movement of parents from the district and migration of the students cannot be analyzed for the whole sample. However, in the case of the area covered by the field study, information descriptive of the mobility patterns of the parental households is available. This is indicated by the number of moves which the household has made since its inception.

The number of times the family head has changed work place was used in order to cover the moves made from farm to farm. For the village households no change was recorded if the change of work place did not involve moving to another community.

The data showing the relationship between present location of the former students and the mobility of their parents are given in table 27. It is seen that there is a high degree of stability in the parental group. One-fourth of them have not changed work place since marriage; one-half have not made more than three moves.

There appears to be no clearly marked relationship between the migration patterns of the family and those of the son or daughter. A larger proportion (71 per cent) of the sons and daughters of those who have moved ten or more times than of the sons and daughters of those who have never moved (58 per cent) are still in the community.

The number of parental moves from zero to six seems to have little effect upon the proportion of sons and daughters still in the community. It is probable that the fluctuation in proportions in the last two classes is due purely to chance.

TABLE 27. MIGRATION OF FORMER STUDENTS IN RELATION TO NUMBER OF MOVES MADE BY HEAD OF PARENTAL HOUSEHOLD

Number of moves made by head of parental household since first marriage	Total	Present status in relation to community: Not in school: Residing in the district	Present status in relation to community: Not in school: Residing outside the district	Present status in relation to community: Away at school
	Number	*Number*	*Number*	*Number*
Total	146	79	55	12
None	36	21	9	6
1–3	36	19	15	2
4–6	38	22	12	4
7–9	22	7	15	0
10 or more	14	10	4	0
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
None	25	27	16	50
1–3	25	24	27	17
4–6	25	27	22	33
7–9	15	9	26	0
10 or more	10	13	7	0

Consequently, there is no evidence in this sample that the number of moves of the parent is associated with movement of sons and daughters from the area of the parental home.

Migration of former students in relation to number of years head of parental household has lived in the community

One other way of measuring the family pattern of mobility is by number of years the head of the household has lived in this community. According to the data supplied by table 28, it is apparent that there is no relationship between the length of time the parent has been in the community and the

TABLE 28. MIGRATION OF FORMER STUDENTS IN RELATION TO NUMBER OF YEARS HEAD OF PARENTAL HOUSEHOLD HAS LIVED IN THE COMMUNITY

Number of years head of parental household has lived in community	Total	Present status in relation to community: Not in school: Residing in the district	Present status in relation to community: Not in school: Residing outside the district	Present status in relation to community: Away at school
	Number	*Number*	*Number*	*Number*
Total	154	86	56	12
1–10	22	14	6	2
11–20	30	20	9	1
21–30	25	11	14	0
31–40	23	12	9	2
41–50	19	9	5	5
51 or more	35	20	13	2
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	56	36	8
1–10	100	64	27	9
11–20	100	67	30	3
21–30	100	44	56	0
31–40	100	52	39	9
41–50	100	48	26	26
51 or more	100	57	37	6

migration of his sons and daughters. Fewer of the sons and daughters from the group resident in the community 21 to 30 years than from any other group are still in the community. But this low point in the middle of the distribution can be accounted for only by chance factors.

Migration of former students in relation to occupation of head of parental household

It has already been pointed out to what a large extent this is a sample of farmers' sons and daughters. Since farming is an occupation which more than any other involves the whole family, it is to be expected that this parental occupation would affect the migration of the sons and daughters. In no other vocation is the occupation passed on from father to son to the extent that it is in farming. Because the home and the farm enterprise are part and parcel of each other, the boy's vocational training is acquired inevitably as a part of growing up. He is already trained for a vocation by the time he finishes high school; what is more natural than that he should remain in a field where he has already acquired some skill, particularly, if the opportunity is open to him to continue in the occupation through inheritance?

Data showing the relationship between the occupation of the family head and the migration of sons and daughters are given in table 29. It is seen that the farm owners' children are more likely to have remained in the community than those of any other occupational group, though the differences are not striking. Of the total group, 36 per cent have left, but only 33 per cent of the farm owners' sons and daughters. More likely to leave are the sons and daughters of the farm tenant, the farm laborer, or farm manager, for whom there is no prospect of inheriting the business. The number of children of farm owners is sufficient to analyze by sexes. It is found, as would be expected, that there is a tendency for more of the

TABLE 29. MIGRATION OF FORMER STUDENTS IN RELATION TO OCCUPATION OF HEAD OF PARENTAL HOUSEHOLD

Occupation of head of parental household	Total	Present status in relation to community		
		Not in school		Away at school
		Residing in the district	Residing outside the district	
	Number	*Number*	*Number*	*Number*
Total	154	86	56	12
Farm owners	61	37	20	4
Farm tenants, managers, and laborers	34	17	16	1
All others	59	32	20	7
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Farm owners	40	43	36	33
Farm tenants, managers, and laborers	22	20	29	8
All others	38	37	35	59
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	56	36	8
Farm owners	100	60	33	7
Farm tenants, managers, and laborers	100	50	47	3
All others	100	54	34	12

sons than of the daughters to remain, 65 per cent as compared with 57 per cent. Only 27 per cent of the farm owners' sons who are no longer in school have left the district, but 37 per cent of the daughters.

The *all others* class covers the non-agricultural group ranging from the professions to the unskilled and unemployed, but there are so few in each occupation, it is useless to break it up.

The proportion of the sons and daughters from all other occupations remaining in the community is almost as large as that of farm owners and even more than that of farm tenants and laborers. This tendency for the sons and daughters of farmers to remain in the community is less than that noted in the section on the place-of-residence factor (table 23 and context) for the farm-reared to remain in the community as compared with those from village homes. Sixteen per cent more of the farm-reared than of the village-reared were still in the community in that case. Here about seven per cent more farm owners' sons and daughters are still in the community and four per cent fewer of the tenants' and farm laborers' sons and daughters are there, as compared with the sons and daughters of all other occupations.

An indirect approach to the problem of the relationship between migration and the parental home may be made by checking the parent household against two personal factors which in the previous analysis appeared to be related to mobility—number of years of schooling and rank in school.

It was found in the previous analysis that those former students who had had training beyond high school tended to leave the community in considerably greater proportions than did those with less schooling. Upon reference to table 30 it is seen that in this sample there appears to be some relation between the occupation of the father and years of schooling beyond high school. Though farm tenants' and farm laborers' sons and daughters make up only 23 per cent of the sample, they make up 29 per cent of those who did not finish high school. However, if they finish high school, the sons and daughters of tenants and farm laborers are almost as likely to go on to college as are the farm owners' sons and daughters, though less likely to finish. The sons and daughters of those in other than agricultural occupations are more likely to go to college or trade school and more likely to finish college.

This appears to introduce an inconsistency because those with more schooling leave the district, but not so many of the sons and daughters of those in other than agricultural occupations leave as of the sons and daughters of farm tenants who have had less schooling. One needs to know, therefore, which sons and daughters do leave in each occupational group, but the sample is too small to warrant sorting for this.

Rank in school work appeared to be related to migration to cities in the larger sample. In table 31 data are presented on the relationship of the father's occupation to the achievement in high school of his sons and daughters. First and second fourths have been combined into the upper half, and the third and fourth fourths into the lower half.

This section of the total sample tends to be a more able group with a preponderance from the upper halves of their classes. This may be significant for the community. It indicates one of two facts. Either the families covered by the area of the field study furnished a majority of the more

TABLE 30. SCHOOLING OF FORMER STUDENTS IN RELATION TO OCCUPATION OF HEAD OF PARENTAL HOUSEHOLD

Occupation of head of parental household	Total	Schooling of former students			
		Some high school	Four years of high school	Some college or normal school, trade school and nurse's training	College graduate
	Number	*Number*	*Number*	*Number*	*Number*
Total	151	48	70	23	10
Farm owner	59	17	31	7	4
Farm tenants, managers, and laborers	34	14	14	5	1
All others	58	17	25	11	5
	Distribution of amount of schooling by parents' occupation				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100
Farm owners	39	35	44	30	40
Farm tenants, managers, and laborers	23	29	20	22	10
All others	38	36	36	48	50
	Distribution of parents' occupation by amount of schooling of students				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	32	46	15	7
Farm owners	100	29	52	12	7
Farm tenants, managers, and laborers	100	41	41	15	3
All others	100	29	43	19	9

TABLE 31. RELATION BETWEEN CLASS RANK IN HIGH SCHOOL OF FORMER STUDENTS AND OCCUPATION OF HEAD OF PARENTAL HOUSEHOLD NOW IN THE COMMUNITY

Occupation of head of parental household	Total	Class rank of former students	
		Upper half	Lower half
	Number	*Number*	*Number*
Total	154	88	66
Farm owners	61	35	26
Farm tenants, managers, and laborers	34	17	17
All others	59	36	23
	Per cent	*Per cent*	*Per cent*
Total or average	100	57	43
Farm owners	100	57	43
Farm tenants, managers, and laborers	100	50	50
All others	100	61	39

able of the school district or those whose families have remained, as contrasted with those who have left, are the more able.

The agricultural occupations do not do quite so well as others in supplying upper-half students, though the difference between children of farm owners and those whose parents have other occupations, is not so great.

Fewer of the tenants' and farm laborers' children are in the upper half of their classes than of those from any other group.

This again presents an inconsistency because in the previous analysis those in the lower class ranks tended to remain in the community. Therefore, fewer of the children of farm tenants and laborers should be leaving the community, rather than more. However, it must be recalled that this covers only a comparatively small portion of the sample. Furthermore, a check of the tenants' and laborers' children might show that those who left were the most able of their group.

Migration of former students in relation to schooling of parents

One other factor in the parental home remains to be discussed in relation to the migration of the sons and daughters, and that is the schooling of the parent. Do the parents who themselves have had less schooling, and less knowledge of other vocations, and who possibly have fewer contacts outside the district, tend to keep their sons and daughters, largely because they cannot put them in touch with other opportunities?

It is found upon referring to table 32 that this appears true. A larger proportion of the sons and daughters of those who had less than eight years of schooling are still in the district. However, the high proportion of the sons and daughters away at school, of the parents who have had more education, makes the comparison difficult, because the proportion who have left the community and are now out of school is also smaller for the sons and daughters of those with more education. However, since most of those now away at school will not return to the community, it can be concluded that there is a greater migration of the sons and daughters of parents with more years of schooling.

TABLE 32. PRESENT LOCATION OF FORMER STUDENTS IN RELATION TO THE SCHOOLING OF THE HEAD OF THE PARENTAL HOUSEHOLD

Schooling of head of parental household	Total	Present status in relation to community		
		Not in school		Away at school
		Non-migrant	Migrant	
	Number	*Number*	*Number*	*Number*
Total	154	86	56	12
Less than eight grades	38	24	14	0
Eight grades	38	21	17	0
Some high school	45	25	16	4
Four years of high school	15	9	5	1
Some college	10	4	3	3
College graduate	8	3	1	4
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	56	36	8
Less than eight grades	100	63	37	0
Eight grades	100	55	45	0
Some high school	100	55	36	9
Four years of high school	100	60	33	7
Some college	100	40	30	30
College graduate	100	38	12	50

In summary, the mobility patterns of the parental household seem to bear no relation to the migrations of sons and daughters. There is a very slight relationship between occupation of parental head and migration of sons and daughters, and between schooling of parental head and migration of sons and daughters.

The numbers are small and what may be taken for relationships may be only chance differences.

OCCUPATIONAL DISTRIBUTION OF FORMER STUDENTS

Movement from one type of work to another involves quite as much adjustment for the individual as does movement from one community to another. To what extent have vocational adjustments also been involved in the mobility of these former students? To what extent have they continued in the occupation which many of them learned as they grew up—farming? This rural community has been proud of the contributions made by its sons and daughters who have left it during the past century, as described in Miss Hoag's bulletin.[13] Is this community continuing to make a contribution to the nation through its sons and daughters? It is to answer these questions as well as to supplement the analysis of spatial mobility, that analysis of occupations of this group of former students is given here.

IN RELATION TO PRESENT LOCATION

In tables 33 and 34 are given data on the occupational distribution of these students in relation to their present place of residence.[14] Almost half the boys are now in agricultural pursuits. Seventeen per cent are farm owners, tenants, or managers; eighteen per cent are farm laborers; and thirteen per cent are working at home on their father's farms. An even higher proportion in agriculture might have been expected in view of the fact that more than three-fourths of these former students resided on farms when they were attending high school.

What occupations other than farming are open to these sons of farmers and villagers? The age of this group must be kept in mind as the occupational factor is analyzed, since a large proportion of them have only recently finished school and have not yet established themselves occupationally.

As yet only five per cent of them are in the professions, but this proportion is certain to be augmented by those who are now in college (table 33). *All others* includes proprietors, managers, skilled workers, semi-skilled, clerical, and unskilled; none of the numbers in these individual classes were large enough to warrant computing percentage on them. These former students have an unusually small number of unemployed among them, as compared with the proportion of unemployed in the total population, or compared with the unemployed among samples covered by youth studies. Some of those who are now classified as working at home might be in the unemployed group had they given the information themselves. This applies in a few cases where the former student is resident in a home covered by the field schedule, and the data were obtained from the parent who might be less inclined to class his son as unemployed than the boy would be. Dickens, in her study, found in comparing parents' answers

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[13] See footnote 4, page 4.

[14] These tables include all of the former students for whom data on occupations were obtained; that is, 362 out of the total group of 408, or 88 per cent. Information was obtained for 92 per cent of the girls and 85 per cent of the boys.

TABLE 33. PRESENT OCCUPATIONS OF FORMER MALE STUDENTS IN RELATION TO PRESENT LOCATIONS WITHIN OR OUTSIDE THE DISTRICT

Present occupation	Total	Present locations		
		Not in school		Away at school
		In the district	Outside the district	Parents in the district
	Number	*Number*	*Number*	*Number*
Total	160	77	75	8
Student	8	0	0	8
Professions	8	2	6	0
Farm operators and managers	27	18	9	0
Farm laborers	29	16	13	0
Working at home	21	19	2	0
All others (non-agricultural)	63	19	44	0
Unemployed	4	3	1	0
	Distribution of present locations by occupations			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Student	5	0	0	100
Professions	5	3	8	
Farm operators and managers	17	23	12	
Farm laborers	18	21	17	
Working at home	13	24	3	
All others (non-agricultural)	39	25	59	
Unemployed	3	4	1	
	Distribution of present occupations by present locations			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	48	47	5
Student	100	0	0	100
Professions	100	25	75	
Farm operators and managers	100	67	33	
Farm laborers	100	55	45	
Working at home	100	90	10	
All others (non-agricultural)	100	30	70	
Unemployed	100	75	25	

with children's answers to questions about the children that there was a tendency for the parent to view the child's residence in the home differently from the son or daughter.[15]

So far as the girls are concerned their singleness of occupation is determined by their sex. More than 50 per cent of them are housewives in their own homes; ten per cent are engaged in housework; and fifteen per cent more are working in the parental home. Thus, three-fourths of them are in domestic occupations. Only eight of a hundred get into professional work, somewhat more than the boys. However, professional ratings for women are attained with shorter training than for men. Nursing and teaching are the professions followed by the girls.

Clerical work does not furnish occupations for as many as might be expected, only eight of a hundred. A slightly larger proportion of the girls than of the boys reported themselves unemployed, possibly because housework occupies them less than farming occupies the boys.

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[15] Dickens, Dorothy. Occupations of sons and daughters of Mississippi cotton farmers. Mississippi State College Agr. Exp. Sta. Bul. 318. 1937.

TABLE 34. PRESENT OCCUPATIONS OF FORMER FEMALE STUDENTS IN RELATION TO PRESENT LOCATIONS WITHIN OR OUTSIDE THE SCHOOL DISTRICT

Present occupation	Total	Present locations		
		Not in school		Away at school
		In the district	Outside the district	Parents in the district
	Number	*Number*	*Number*	*Number*
Total	200	79	112	9
Student	9	0	0	9
Professional	15	0	15	0
Clerical and semi-skilled	16	8	8	0
Working at home	31	22	9	0
Housewife	102	34	68	0
Housework and other unskilled	20	10	10	0
Unemployed and incapacitated	7	5	2	0
	Distribution of present locations by present occupations			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Student	5			100
Professional	8		13	
Clerical and semi-skilled	8	10	7	
Working at home	15	28	8	
Housewife	50	43	61	
Housework and other unskilled	10	13	9	
Unemployed and incapacitated	4	6	2	
	Distribution of present occupations by present locations			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	40	56	4
Student	100			100
Professional	100		100	
Clerical and semi-skilled	100	50	50	
Working at home	100	71	29	
Housewife	100	33	67	
Housework and other unskilled	100	50	50	
Unemployed and incapacitated	100	71	29	

This study serves to emphasize the importance of the training for homemaking for high-school girls, since that is the occupation to which most of them give the majority of their years. Many have two vocations to prepare for: the one which is followed for a few years preceding marriage, such as teaching, stenography, nursing; and that which they will follow most of their lives, homemaking.

So far as the relation between occupation and place of residence is concerned, it is necessary to keep in mind the preponderance of younger people in the district, which affects the differences in occupational distribution of those in the district as compared with those who have left. It is pointed out in the analysis of factors affecting migration that age is important and that as these students grow older they will move out of the district in larger proportions, and with migration will come change in occupation. One source of considerable difference between those still in the district and those who have migrated is the class *working at home*. This undoubtedly is a temporary condition for a large number of both sexes, but particularly for the boys. Twenty-five per cent of the males still in the community are in this class, but only three per cent of those who are gone.

The greatest difference between the residents in the district and those who have left is in the non-agricultural occupations. About one-fourth of those who are still in the district are in skilled, semi-skilled, unskilled, and clerical occupations, but fifty-nine per cent of those who are gone from the district are in such occupations.[16]

It follows from this fact that a smaller proportion of those who have left the district are in agricultural occupations. There are only about half as many farm operators among those who have left the community as among those who are still there.

For the women there seems to be a good deal of difference in occupational proportions between those still in the district and those who have migrated. Only those who have left are in professional occupations. Those who have left are more likely to be married, a fact which follows from the differences in age distribution as is brought out later. They are less likely to be doing housework or other unskilled work, which in the community is usually waiting on table in a restaurant or resort. Even more of the girls than the boys who are still in the district are working at home, and there is a difference of twenty per cent between the proportions of the girls still in the district and those who have left in this occupational group.

As with the men, the differences in proportions between the two residential groups may be due in large part to the fact that the group still in the district is the younger.

IN RELATION TO AGE

Data on the relationship of age to occupation for this particular sample are given in tables 35 and 36. These tables show interesting changes in proportions in the various occupational groups as one follows across from age group to age group. As might be expected, there is a steadily increasing proportion of farm operators, and a decreasing proportion of farm laborers. The range in farm operators is from three per cent in the group under 21, to 30 per cent in the group over 30. Thirty-three per cent of the group under 21 are farm laborers, but this occupation accounts for only four per cent of the group over 30. It is interesting to observe the sharp decrease (20 per cent) in the proportion of those working at home when the group under 21 is compared with the next age group, 21 to 25. After that change the proportion remains almost the same for the other age groups. A concomitant of this fact is the pronounced increase in the proportion in non-agricultural occupations when comparison is made between the group under 21 and the one next above, 21 to 25. Twenty-six per cent more of the group 21 to 25 are in non-agricultural occupations than of the group under 21. In the group over 25 more than half are in non-agricultural occupations.

In the case of the female distribution similar significant changes in proportions are found as younger groups are compared with older. There is a similar decrease in the proportion working at home, though this is not so uniform as for the males. Most significant is the steady increase with increase in age in the proportion who are housewives in their own homes.

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[16] A large number of those in this group who are still in the district are truck and bus drivers.

TABLE 35. PRESENT OCCUPATIONS OF FORMER MALE STUDENTS IN RELATION TO AGE

Present occupation	Total	Present age in years			
		Under 21	21–25	26–30	Over 30
	Number	*Number*	*Number*	*Number*	*Number*
Total	155	33	51	48	23
Student	9	6	3	0	0
Professions	8	0	2	3	3
Farm operators and managers	27	1	6	13	7
Farm laborers	28	11	12	4	1
Working at home	21	10	5	4	2
Unemployed	4	0	2	2	0
Other unskilled and all other (non-agricultural)	58	5	21	22	10
	Distribution of age classes by occupations				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100
Student	6	18	6		
Professions	5		4	6	13
Farm operators and managers	17	3	12	27	30
Farm laborers	18		24	8	4
Working at home	14	34	10	8	9
Unemployed	3	30	4	4	
Other unskilled and all other (non-agricultural)	37	15	40	47	44
	Distribution of occupations by age classes				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	21	33	31	15
Student	100	67	33		
Professions	100		25	37	38
Farm operators and managers	100	4	22	48	26
Farm laborers	100	39	43	14	4
Working at home	100	47	24	19	10
Unemployed	100		*	*	
Other unskilled and all other (non-agricultural)	100	9	36	38	17

*Numbers too small to figure percentages on them.

From the first to the second group the proportion doubles. At 25, more than half are housewives. In the next group, 26 to 30, about ten per cent more find employment in this occupation, and in the group over 30, another twelve per cent are so classified. Not quite three-fourths of those in this oldest group are housewives.[17]

It is interesting to note the increase in the proportions in the professions from age group to age group, from two per cent in the youngest group to 13 per cent in the oldest. The sample is too small to warrant emphasizing these proportions but there is a possibility that age is not the only factor in this increasing proportion in the professions. It may be that opportunities for professional training are not open to the more recent students as they were earlier. Furthermore the earlier classes were more selective. A smaller number entered high school, and a larger proportion were of professional caliber. Entrance into the teaching profession has become increasingly difficult as longer terms of training are required. These hypotheses could be tested only by a larger sample.

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[17] It is to be noted that this is not the same as married, since this is an occupational classification, and if married women hold positions outside the home they are classified according to that occupation.

TABLE 36. PRESENT OCCUPATIONS OF FORMER FEMALE STUDENTS IN RELATION TO AGE

Present occupation	Total	Present age in years			
		Under 21	21–25	26–30	Over 30
	Number	*Number*	*Number*	*Number*	*Number*
Total	194	56	59	49	30
Student	10	6	4	0	0
Professions	14	1	4	5	4
Clerical and semi-skilled	15	5	6	2	2
Working at home	29	17	4	6	2
Housewife	99	15	32	30	22
Housework and other unskilled	20	8	6	6	0
Unemployed	7	4	3	0	0
	Distribution of age classes by occupations				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100
Student	5	11	7		
Professions	7	2	7	10	13
Clerical and semi-skilled	8	9	10	4	7
Working at home	15	30	7	12	7
Housewife	51	27	54	62	73
Housework and other unskilled	10	14	10	12	
Unemployed	4	7	5		
	Distribution of occupations by age classes				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	29	30	25	16
Student	100	60	40		
Professions	100	7	29	35	29
Clerical and semi-skilled	100	33	41	13	13
Working at home	100	58	14	21	7
Housewife	100	15	33	30	22
Housework and other unskilled	100	40	30	30	
Unemployed	100	*	*		

*Numbers too small to figure percentages on them.

The conclusion to be drawn from tables 35 and 36 is that, even in this narrow range, age and occupation are related for both sexes. For the men, the shift from agricultural to non-agricultural occupations is not great after 25 years of age. For the woman, the change is largely from the status of helpers in the parents' homes to homemakers in their own. The greatest change for them comes in the years from 21 to 25.

IN RELATION TO CLASS RANK

In tables 37 and 38 the former students are grouped according to their rank in the upper and lower halves of their classes. The distribution of the upper- and lower-half groups in the various occupations is difficult to analyze because more of the boys are in the lower halves of their classes, in high school. Therefore when males are analyzed separately, it is found that only two-fifths of them are from the upper halves of their classes. Therefore comparison between occupations by the proportion contributed to each occupation by the upper and lower halves of the classes seems most desirable. It is seen that the greatest difference between the upper and lower halves is in the professions.

TABLE 37. PRESENT OCCUPATION OF FORMER MALE STUDENTS IN RELATION TO CLASS RANK WHILE IN HIGH SCHOOL

Present occupation	Class rank		
	Total	Upper half of class	Lower half of class
	Number	*Number*	*Number*
Total	161	65	96
Student	9	5	4
Professions	8	7	1
Farm operators and managers	27	9	18
Farm laborers	29	9	20
Working at home	21	11	10
Unemployed	4	1	3
Other unskilled and all other (non-agricultural)	63	23	40
	Distribution of class ranks by present occupation		
	Per cent	*Per cent*	*Per cent*
Total	100	100	100
Student	6	8	4
Professions	5	11	1
Farm operators and managers	17	14	19
Farm laborers	18	14	21
Working at home	13	17	10
Unemployed	3	2	3
Other unskilled and all other (non-agricultural)	38	34	42
	Distribution of present occupation by class ranks		
	Per cent	*Per cent*	*Per cent*
Total or average	100	40	60
Student	100	56	44
Professions	100	88	12
Farm operators and managers	100	33	67
Farm laborers	100	31	69
Working at home	100	52	48
Unemployed	100	25	75
Other unskilled and all other (non-agricultural)	100	37	63

Though only forty per cent of all males come from the upper halves of their classes, eighty-eight per cent of those in the professions come from the upper group. Though the numbers are small this difference is large enough to be significant. Only 33 per cent of the farm operators and 31 per cent of the farm laborers are from the upper group. These are small differences but they are consistent with the trends pointed out in the previous section on class ranks. All other non-agricultural occupations have only a few more of the upper group than have the agricultural.

It is expected that the proportions of the female students from the upper and lower halves of their classes would be the reverse of the proportions for the male students. Fifty-nine per cent of the girls were in the upper ranks of their classes. In this case the greatest difference between occupations is in the student group. One hundred per cent of them are from the upper half.

The same difference in the professions is to be noted here also. Eighty-eight per cent of the women in professions ranked in the upper half of their classes. The clerical and semi-skilled occupations get a slightly larger proportion than their expected share of upper-half students. Unlike the boys who are working at home, the girls in this group seem to be

TABLE 38. PRESENT OCCUPATIONS OF FORMER FEMALE STUDENTS IN RELATION TO CLASS RANKS WHILE IN HIGH SCHOOL

Present occupation	Total	Class rank: Upper half of class	Class rank: Lower half of class
	Number	*Number*	*Number*
Total	201	118	83
Student	10	10	0
Professions	15	13	2
Clerical and semi-skilled	16	11	5
Working at home	31	15	16
Housewife	102	56	46
Housework and other unskilled	20	8	12
Unemployed	7	5	2
	Distribution of class ranks by present occupations		
	Per cent	*Per cent*	*Per cent*
Total	100	100	100
Student	5	9	
Professions	8	11	2
Clerical and semi-skilled	8	9	6
Working at home	15	13	19
Housewife	50	47	56
Housework and other unskilled	10	7	15
Unemployed	4	4	2
	Distribution of present occupations by class ranks		
	Per cent	*Per cent*	*Per cent*
Total or average	100	59	41
Student	100	100	
Professions	100	87	13
Clerical and semi-skilled	100	69	31
Working at home	100	48	52
Housewife	100	55	45
Housework and other unskilled	100	40	60
Unemployed	100	71	29

less able scholastically. The proportion from the upper half among the housewives is slightly less than the proportion in the whole sample from the upper half. Still less of the upper-half members make up the group doing housework or other unskilled work.

It appears, therefore, that to a limited extent occupation and achievement in school are related. Only the more able academically got into the professional group or have gone on to schools and colleges in preparation for entering the professions. There appears to be some tendency for those who were more able scholastically to leave farming. Slightly less of the more able among the girls are in domestic occupations, including homemaking. As pointed out in the discussion under age distribution many of those who are still at home will be placed occupationally in a few years. A follow-up on the group five or ten years hence would give more complete information on the relationship of scholastic rank to occupation since the present occupations are by no means permanent.

IN RELATION TO PLACE OF RESIDENCE WHILE ATTENDING HIGH SCHOOL

It has been suggested that not all those living on farms are in farming as an occupation. Therefore, a check on the relationship of place of residence while in school to present occupation offers some refinement on the previous analysis of the factor of place of residence while in school.

The data on occupation and place of residence while in high school are given in tables 39 and 40. Eighty-two per cent of the males came from farms and this preponderance must be kept in mind in analyzing the table. The farm-reared males do not contribute to the professions to the extent that the village-reared do. Only two per cent of the farm-reared are in professions, as compared with 14 per cent of the village-reared. Nor are the farm-reared preparing for professions to the extent that the village-reared are, as indicated by those away at school. As would be expected, few village- or non-farm-reared have become farm operators, though 14 per cent of them are farm laborers. These may be the farm laborers who as they grow older get into the non-agricultural occupations.

TABLE 39. Present Occupations of Former Male Students in Relation to Place of Residence While Attending High School

Present occupation	Total	Place of residence while in school	
		Village or non-farm home	Farm
	Number	*Number*	*Number*
Total	158	28	130
Student	8	3	5
Professions	7	4	3
Farm operators and managers	27	1	26
Farm laborers	29	4	25
Working at home	21	0	21
Unemployed	4	0	4
Other unskilled and all other (non-agricultural)	62	16	46
	Distribution of place of residence while in high school by present occupations		
	Per cent	*Per cent*	*Per cent*
Total	100	100	100
Student	5	11	4
Professions	4	14	2
Farm operators and managers	17	4	20
Farm laborers	18	14	19
Working at home	13		16
Unemployed	3		3
Other unskilled and all other (non-agricultural)	40	57	36
	Distribution of present occupations by place of residence while in high school		
	Per cent	*Per cent*	*Per cent*
Total or average	100	18	82
Student	100	38	62
Professions	100	57	43
Farm operators and managers	100	4	96
Farm laborers	100	14	86
Working at home	100		100
Unemployed	100		100
Other unskilled and all other (non-agricultural)	100	26	74

The difference in proportions of village-reared and farm-reared making up the girls' sample is not quite so great but the farm-reared girls outnumber the village-reared three to one. A larger proportion of the village-reared are going away to school, but a slightly larger proportion of the

TABLE 40. PRESENT OCCUPATIONS OF FORMER FEMALE STUDENTS IN RELATION TO PLACE OF RESIDENCE WHILE ATTENDING HIGH SCHOOL

Present occupation	Total	Place of residence while in school	
		Village or non-farm home	Farm
	Number	*Number*	*Number*
Total	198	47	151
Student	10	5	5
Professions	14	3	11
Clerical and semi-skilled	16	3	13
Working at home	31	7	24
Housewife	100	21	79
Housework and other unskilled	20	7	13
Unemployed	7	1	6
	Distribution of place of residence while in high school by present occupations		
	Per cent	*Per cent*	*Per cent*
Total	100	100	100
Student	5	11	3
Professions	7	6	7
Clerical and semi-skilled	8	6	9
Working at home	16	15	16
Housewife	50	45	52
Housework and other unskilled	10	15	9
Unemployed	4	2	4
	Distribution of present occupations by place of residence while in high school		
	Per cent	*Per cent*	*Per cent*
Total or average	100	24	76
Student	100	50	50
Professions	100	21	79
Clerical and semi-skilled	100	19	81
Working at home	100	23	77
Housewife	100	21	79
Housework and other unskilled	100	35	65
Unemployed	100	14	86

farm-reared are already in professions. A substantially larger proportion of the farm-reared are married. A larger proportion of village and non-farm girls are doing housework, or acting as nursemaids or waitresses.

Place of residence while attending high school seems to be more closely related to professional and agricultural occupations than to others. It is more closely related to occupation in the case of the boys than in the case of the girls.

SUMMARY

It appears that of the factors studied age is probably more closely related to present occupation than to any other, at least until the age of 25 is reached. After that changes in proportions are small between age groups.

Scholastic achievement is related to occupation only when professions are considered. If the sample were larger and the *all other* non-agricultural occupations could be broken down, greater relationship might be found.

Place of residence while attending high school is related to farming and the professions. The other occupations attract about equal proportions of farm-reared and of village-reared individuals.

SUMMARY AND CONCLUSIONS

This bulletin states the findings regarding migration and the factors associated with it for 339 former students enrolled in Belleville Union Academy between the years 1919 and 1938. Forty-nine per cent of them have taken up residence outside the district and another five per cent are attending school outside the district. Almost one-fifth of the whole group are now city dwellers, and almost forty per cent of the migrants moved to cities.

Age data show that the proportion who have left the community has increased with age. Fifty-four per cent of those 21 years of age and over have migrated, as compared with 49 per cent for the whole group. The proportion of migrants in cities has also increased with age. Twenty-three per cent of those 21 years of age and over are in cities, as compared with only 6 per cent of those under 21.

More women than men have left the area and a larger proportion of the female migrants than of the male migrants went to cities.

Fifty-two per cent of the migrants and 44 per cent of the non-migrants came from the upper halves of their classes. Or stated another way, 41 per cent of the scholastically more able group remained in the district and 51 per cent migrated. The balance are away at school. Fifty-three per cent of those on farms, 49 per cent of those in villages, and 37 per cent of those in cities were from the lower halves of their classes.

Forty-seven per cent of all the former students now on farms, 51 per cent of those in villages, and 63 per cent of those in cities were in the upper halves of their classes when in high school.

If the selective process which has affected the migrations of the older members of the group continues to operate in the same way upon the younger members, the selection of migrants on the basis of scholastic ability will eventually be much greater for this group. Estimates made on the basis of the data for the oldest members of the group suggested that ten years hence at least 65 per cent of all those who were in the upper halves of their classes when in high school will have migrated, but only 46 per cent of those from the lower halves will have left. Stated conversely only 35 per cent of the better students will be in the district and 54 per cent of the less able will be there. From the point of view of the population of the community it was estimated that of those who will still be in the community ten years from now, 39 per cent will be from the upper scholastic group and 61 per cent from the lower.

Twelve per cent more of those who have left than of those who remained had training beyond high school. Twenty-four per cent more of those now in cities than of those in rural areas had training beyond high school.

Seven per cent more of the village-reared than of the farm-reared students have left the district. The proportion of village-reared in cities is twice that of farm-reared.

Half the men were in agriculture. Three-fourths of the women were in domestic occupations, including homemaking in their own homes. The men who remained in the community remained to follow agricultural pursuits to a large extent. Sixty-eight per cent of those who left went into non-agricultural occupations. The occupations of fathers and sons were closely related in the case of the agricultural occupations.

Selection of migrants is taking place on the basis of age, sex, ability as measured by grades obtained in high-school work, on years of schooling, and on the basis of place of residence while attending high school; that is, in farm or village homes. More pronounced is the effect of these factors in selecting out the migrants to the cities.

The nature of these selective factors suggests that migration is dependent upon the need to find the vocational opportunity which is lacking in the community or to find greater opportunity than it offers to those whose achievements in high school may indicate greater ability.

Conclusions regarding the seriousness of the selectivity on the basis of ability as measured by school grades depend upon acceptance of the estimates made regarding the probable future situation, and upon the degree to which scholastic ability is accepted as an index of mental ability, as pointed out on page 17. Assuming their acceptance, the seriousness of the selectivity of this factor is evident.

If the population in the community in the most productive years of life is composed of more and less scholastically able in a proportion of 2 to 3, it must follow that the community will have a different character than if it had kept a larger proportion of its more able. If it is composed of larger proportions of those with fewer years of schooling, it must be disadvantaged in its competition with urban communities. It must eventually accept leadership from those communities to which it has sent the larger proportion of its better educated and more able young people. It seems reasonable to conclude that some of the lack of interest in community activities and institutions and the disintegration of community solidarity might be accounted for by the selective character of migration from the community.

The implications of this study must necessarily be circumscribed since the area covered is not necessarily a representative sample of either rural New York or rural America. These conclusions and implications apply only to this community, though this study, in combination with other studies of similar findings and covering a representative sampling of rural areas, may eventually be used for generalizations of wider application.

This community does not represent a case of over-migration, the problem with which such writers as Miss Hoag were concerned 19 years ago, but instead a problem of selectivity. There is probably no more migration out of the community than is desirable in view of the decreasing need for workers in agriculture and in occupations requiring training. In fact the writer was impressed with what seemed a wholesome condition so far as employment of young people in the community is concerned, and it is well that so many have been able to find opportunity elsewhere.

It is desirable that a substantial proportion of the young people leave, but it is undesirable from the point of view of the community that the group who leave continue to carry with them the larger part of the more able and better educated. How may this difficulty be met? It was Miss Hoag's suggestion that strong institutions would make the community attractive to its young people.

> The universal cry of "keep the boy on the farm" can be expanded into a great public sentiment for establishing at the very door of the farms the institutions which all people crave. Neither exhortation nor force will keep people on farms, away from the best of the life of the world; but when the tide of the world flows up into the

> country and deposits its riches of thought on the institutional threshold of farm life, the great social motive of youth and middle age for leaving the farms will be undermined . . . . The weak, helpless cry of "keep the boy on the farm" can be transformed into a rallying cry: "Build great community institutions for farm boys and girls."[18]

One wonders, however, if the institution of the school at least did not open the way for greater opportunities to achieve social and economic status elsewhere.

It is believed that the conclusions regarding the reasons for migration imply clearly the problem before this and all other rural communities in which selective migration is taking place—to offer opportunities to their more scholastically able young people to win satisfactions equivalent to those which the same effort applied elsewhere would win for them. Those whose standards have been raised by life at college or other schools outside the community those who have been assured of their abilities through success in school are the more likely to go where sufficient return for their efforts can be obtained.

This problem is rooted in the difficulties of agriculture at the present time, and so far as the findings of this study are verified by studies of other rural areas, it furnishes support for any state or nation-wide efforts to decrease the differential in income and status between agriculture and other occupations.

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[18] See footnote 4, page 4. (Reference cited above is on page 53.)

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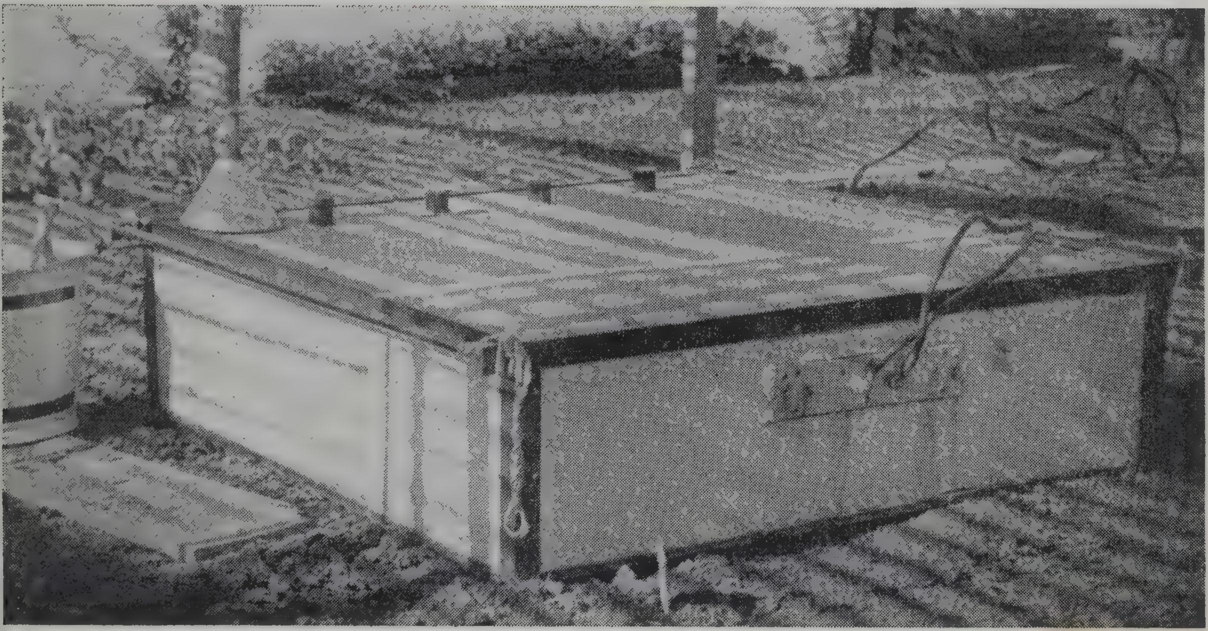
Experiments with New Electric Devices for Pasteurizing Soils

A. G. Newhall



AN ELECTRICALLY OPERATED INVERTED STEAM PAN FOR GREENHOUSE OR OUTSIDE USE

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EXPERIMENTS WITH NEW ELECTRIC DEVICES FOR PASTEURIZING SOILS[1]

A. G. Newhall

The many advantages of heat as an agent for disinfesting soils, particularly soils that have become unproductive from the accumulation of parasitic fungi, nematodes, weed seeds, and insect pests, have long been recognized. Heat is quick and transient, but is very thorough. It destroys all pests. Many growers of flowers and vegetables who do not have equipment to steam-"sterilize" are finding that limited quantities of soil can be economically and satisfactorily "pasteurized" with some sort of electrical device.

METHODS OF SOIL-PASTEURIZING

DIRECT-HEATING METHOD

Two general methods involving the use of different kinds of electrical equipment have been developed. In one, the direct-heating method, the soil-resistance principle is employed in which the current passes directly through the soil from one metal plate, or electrode, to another. Charles W. Wildebour appears to have been the first to employ the method in America (Anonymous, 1932). He and Glen Cushing worked in cooperation with C. F. Doucette, then in charge of the entomological laboratory of the United States Department of Agriculture at Sumner, Washington. They heated 20 square feet of bench soil at a time, from 60° to 180° F. in about two hours, with 70 kilowatt-hours on 230-volt alternating current. A year later, Fee (1933) described the successful use of vertical plates in a greenhouse bench where 15 square feet was treated at a time on a 30-ampere 230-volt alternating-current line. Similar results were obtained in the same year by Krewatch and Kable (1933), who made a comprehensive report on the procedure and pointed out a number of the limitations and difficulties involved in applying this method to the treatment of bench soil and ground beds.

A box type of pasteurizer also was developed in the Washington experiments described by Scott (1932). This was capable of raising the temperature of about ¾ cubic foot of soil to 180° F. in 4½ minutes by employing vertical metal blades (electrodes) 2 inches apart in a box 12 by 18½ inches in size and 5½ inches deep. Blauser (1934?, 1935) improved on the construction of this cabinet type by employing but two horizontal electrodes 10 inches apart, in place of numerous vertical ones. He was able to obtain satisfactory temperatures with the expenditure of less than 1 kilowatt-hour per cubic foot of soil. He stated that resistance to the current was directly proportional to the distance apart of the electrodes and inversely proportional to their area. As a standard size for a pasteurizer to be used on 230-volt alternating current and where a maximum service of 50 amperes was available, he settled on one 24 by 36 inches in size and 10 inches deep; but he stated that if a maximum of only 25 amperes was available, the dimensions should be cut to 24 by 18 by 10 inches. If the depth was reduced to 5 inches, the demand would then be equal to that of the larger pasteurizer while the volume would be cut to one-fourth; and hence the time required to reach the end point, and the total current consumed, would also be but one-fourth of those with the larger box. The work of Tavernetti (1935) confirmed the results obtained by others.

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[1] This is one of several agricultural-research projects undertaken with funds supplied by the Empire State Gas & Electric Association.

Newhall and Nixon (1935) made a study of the direct-heating (Ohio) type of cabinet pasteurizer (figure 1), and found that the current consumed per cubic foot of soil per degree rise in temperature ranged from 22 watts for sand to 28 watts for muck with its higher water content. Greater efficiency than this has recently been obtained by Cruz (1939), who employed a constant-current transformer which automatically stepped up the voltage whenever the charge of soil had a relatively high resistance (as sand) and reduced the voltage when a soil with high conductivity (as muck or compost) was being heated. In general, the experiments in America clearly indicate that a cubic foot of soil can be heated sufficiently to kill pathogenic microorganisms and weed seeds with about 1 kilowatt-hour of electricity when 230 volts are used, and with even less if higher voltages can be employed.

In Europe, similar experiments have been conducted with direct-heating equipment along parallel lines with those in America. Dix and Rauterberg

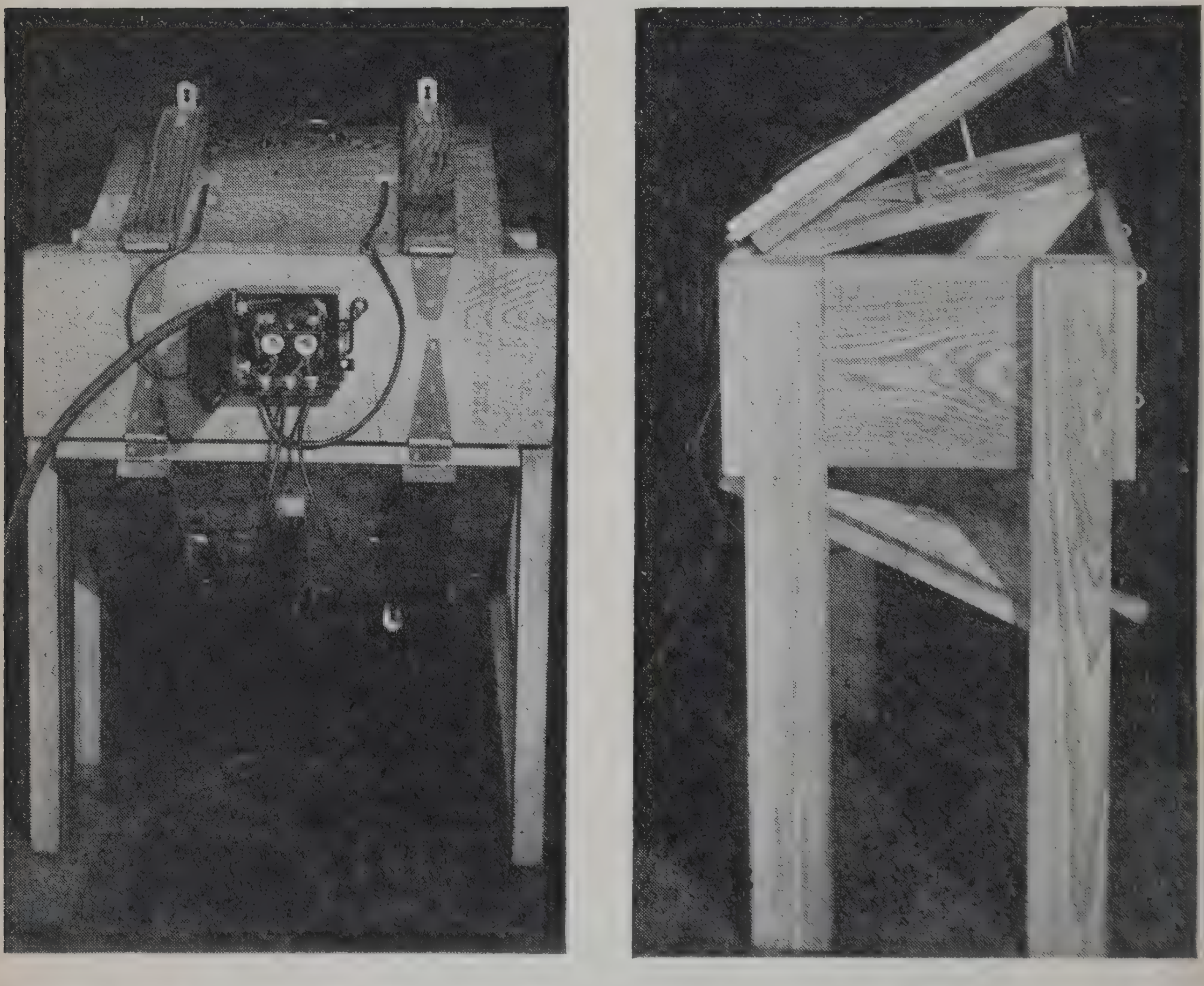

FIGURE 1. A DIRECT-HEATING SOIL PASTEURIZER, OHIO TYPE, WITH A CAPACITY OF 2.4 CUBIC FEET

The current passes directly through soil from one horizontal electrode to another. On 230-volt alternating current, it takes from 25 minutes to 6 hours to treat a charge of soil. The current demand is variable, and exceeds 5 kilowatts under some soil conditions

(1933), in Germany, used a three-phase circuit and a transformer with a capacity of 3.6 to 60 amperes at voltages between 2750 and 200. Seven parallel vertical electrodes were placed in the soil at intervals varying between 8 and 78 inches in different experiments. The best results were said to have been obtained when electrodes were approximately 20 inches apart and a 500-volt current was employed. By using strong currents for relatively short periods of time, greater economy was obtained. Thus a cubic yard of soil could be brought up to 70° or 80° C[2] with 9 to 16 kilowatt-hours, or less than ½ kilowatt-hour per cubic foot.

Both the American and the European experiments have shown that success with the vertical-plate method of direct heating requires a transformer, which is costly, that certain hazards to life and loss of current are hard to avoid, and that unless considerable labor and careful attention to details are employed uniform results cannot be expected. As a consequence, the vertical-plate direct-heating method has not found favor with practical growers.

Experiments with horizontal electrodes in a cabinet-type pasteurizer were conducted in Holland by Kroft and Groen (1933). Muyzenberg and Rijn (1937) then studied the device more thoroughly with respect to the effect of electrolytes, moisture, and compression on the conductivity of sand and soil. Their figures for current consumption were high—from 1.6 to 4+ kilowatt-hours per cubic foot—but their final temperatures were also rather high (99° C.).

Certain objectionable features of the direct-heating method include hazards to the operator, the variable and often very high demand made on the service line, and the care required in loading the chamber with soil to get uniformity in packing, in moisture content, and in contact between soil and electrodes, not to mention the frequent necessity of adding some dilute electolyte solution (sodium or potassium nitrate or sulfate) to increase the conductivity of sand. Taken all together, these are believed by many to outweigh the advantages of economy of construction and speed of operation pertaining to the direct-heating type of cabinet.

INDIRECT-HEATING METHOD

The other general method of soil-heating employs the heating-element principle in which the current passes through covered, resistance, heating units properly spaced to impart their heat to the soil by

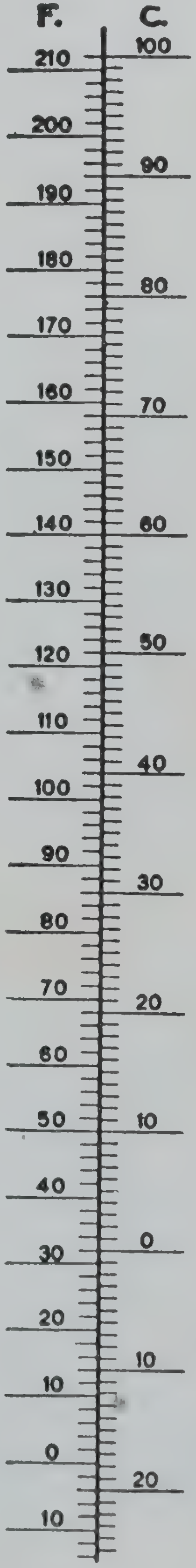

FIGURE 2. FAHRENHEIT-CENTIGRADE CONVERSION SCALE

thermal conductance. Cabinet pasteurizers operating on this principle, first described by Carney (1932) and further tested by Horsfall (1935) and by Newhall and Nixon (1935), have become known as the New York type (figures 3 and 4).

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[2] A centigrade-Fahrenheit temperature-conversion scale is shown in figure 2.

Newhall and Nixon found this kind of pasteurizer capable of heating soils to satisfactory temperatures (70° C.) with the expenditure of electric energy varying between 1.0 and 1.3 kilowatt-hours per cubic foot of soil treated, depending on the kind of soil, the initial temperature, and the moisture content. They concluded that the sum total of the advantages and disadvantages of the two general methods of pasteurizing was in favor of the indirect, because of its greater safety and simpler operation. They built cabinets holding up to 3 or 4 cubic feet of soil for $20 to $30, and

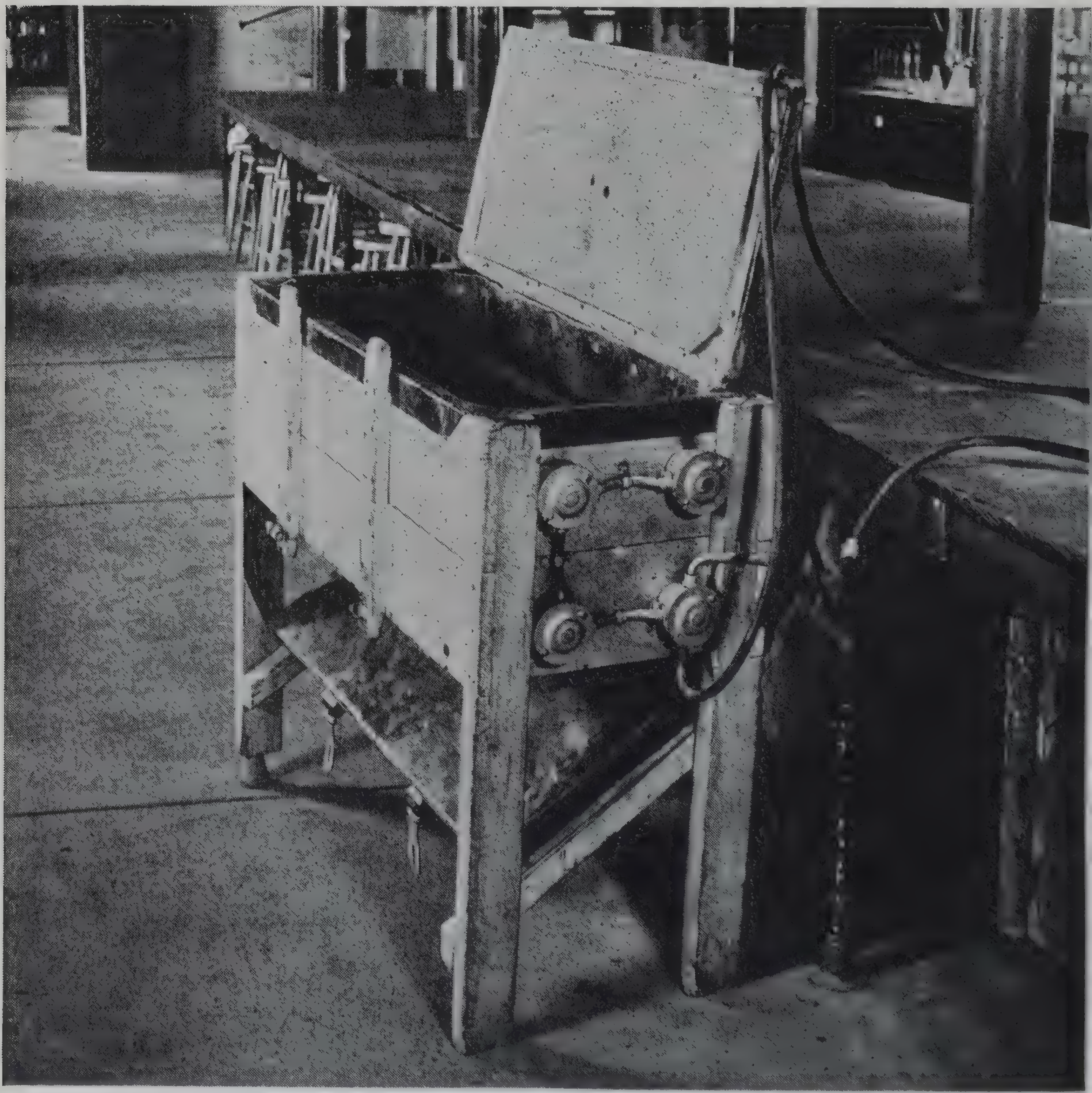

FIGURE 3. AN INDIRECT-HEATING SOIL PASTEURIZER, NEW YORK TYPE, WITH A CAPACITY OF 5 CUBIC FEET

This may be used on either 115- or 230-volt alternating current. Pipe-type space heaters with a constant-current demand of 1600 watts, are employed. It takes 4 to 5 hours to treat a charge of soil. The pasteurizer is lined with copper and insulated with composition board and has been in use for over four years without repair

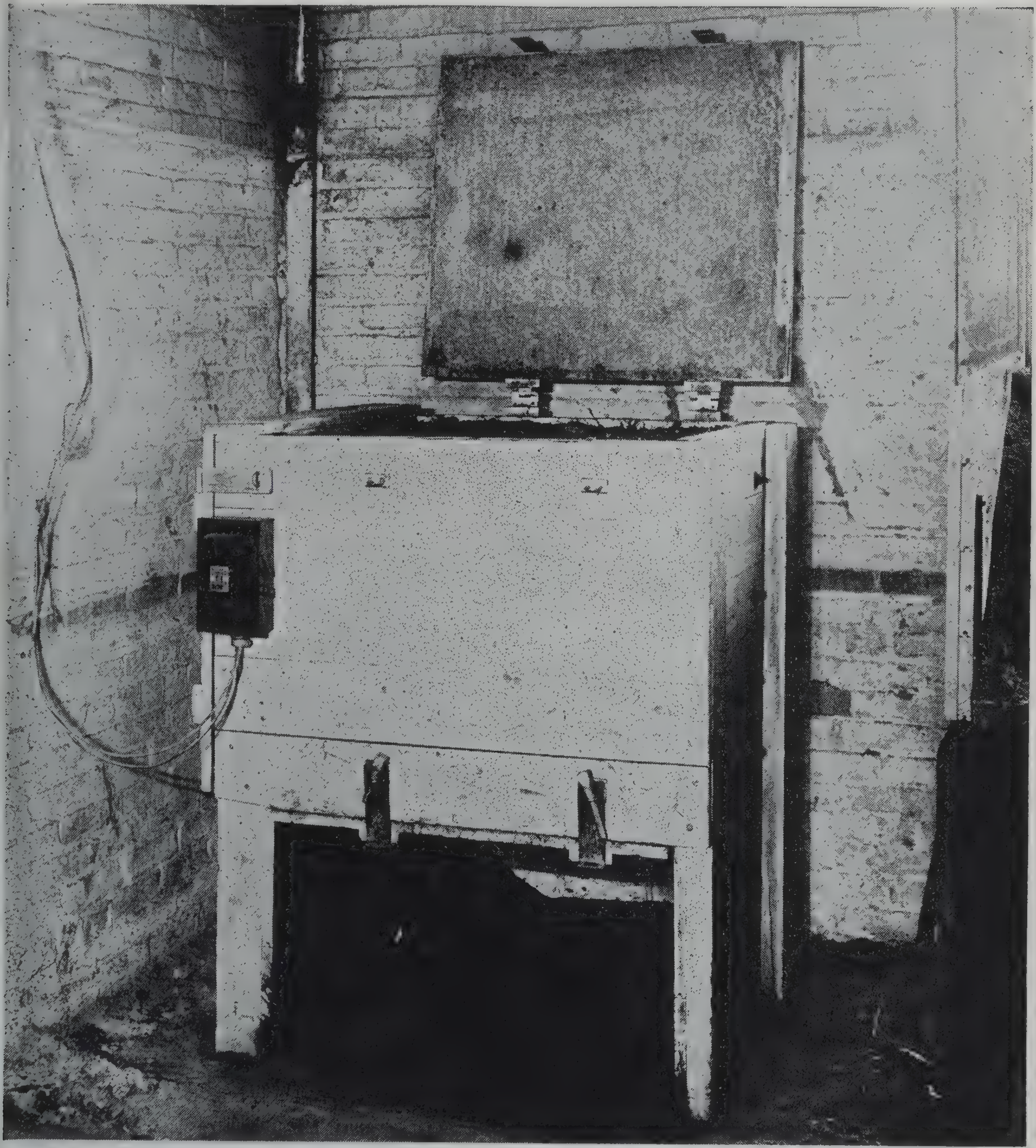

FIGURE 4. A POPULAR, SERVICEABLE, INDIRECT-HEATING SOIL PASTEURIZER, NEW YORK TYPE, WITH A CAPACITY OF ½ CUBIC YARD

This is equipped with "Calrod" heaters rating 3000 watts, and may be used on either 115- or 230-volt alternating current

assembled one holding ½ cubic yard for $67. Since 1931, when these were originally designed, there have probably been more than 100 such pasteurizers, of different sizes, purchased or built by growers in New York and neighboring States[3]. The largest are believed to hold 1 cubic yard, while the most popular seems to be the ½-cubic-yard size which operates on either 115 or 230 volts and has a connected load of 3000 watts, or 222 watts per cubic foot.[4]

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[3] From information supplied by manufacturers.

[4] Since these experiments were completed, a handy-sized portable electric pasteurizer holding 2 bushels of soil has been placed on the market. It is shaped like a large suitcase, contains one 750-watt Calrod heater, and has been giving satisfactory service in the Department of Entomology and Limnology at Cornell University. This pasteurizer is illustrated in figure 9.

The matter of the wattage required and the proper spacing of the heaters was studied by Newhall and Nixon. They found that a considerable leeway is permissible in this respect. With pipe-type heaters of ¾-inch galvanized iron, which can be obtained in almost any desired length and wattage rating,[5] good results were obtained when the heat flux per square inch of heater surface varied between 2.12 and 2.45 watts. Heaters should be so rated and so spaced as to deliver from 200 to 300 watts per cubic foot of soil, and no portion of the soil should be more than 8 inches from a heater.

THERMAL DEATH-POINTS OF PATHOGENIC MICROORGANISMS

In a former publication the author gave evidence that in the presence of ordinary soil moistures a final temperature of 70° C. is high enough to kill a variety of pathogenic microorganisms, including members of such genera as Rhizoctonia, Sclerotinia, Phytophthora, Fusarium, Heterodera, and Erwinia, in less than an hour (Newhall and Nixon, 1935). Blauser (1935) concluded that 60° C. is high enough to kill nematodes (Heterodera) and most weed seeds, but that 65° is required to kill the Fusarium causing tomato wilt. Horsfall (1935) has noted the efficacy of long-time low-temperature treatment for damping-off control, 45° to 55° C. having been found high enough in some cases where an overnight treatment was made.

To test the supposition that 60° C. is a sufficiently high end temperature for damping-off control, a number of flats of soil known to possess damping-off organisms were heated in a Nixon dairy-utensil sterilizer (described later) until the following temperatures were reached: 40°, 45°, 50°, 55°, 60°, and 95° C. Each flat was subsequently sown with vegetable seeds, and records of damping-off were kept. The results indicated that heating

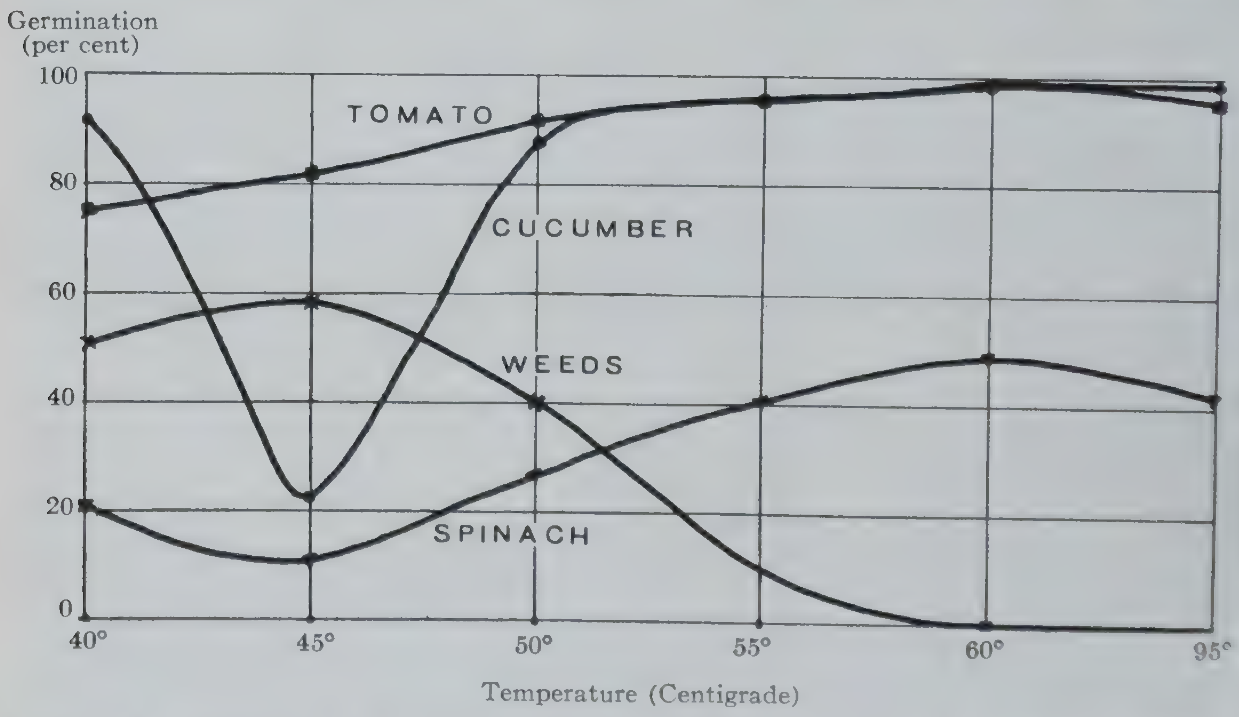

FIGURE 5. EFFECT OF HEATING LOAM SOIL TO CERTAIN FINAL TEMPERATURES, ON DAMPING OFF OF SOME VEGETABLE SEEDS AND ON GERMINATION OF WEED SEEDS

The germination in untreated soil was as follows: spinach, 13 per cent; tomato, 77 per cent; cucumber, 95 per cent; weeds, 45 per flat to 60° was as effective as was heating to 95°. Perhaps the time factor is of importance here, as it took three hours to attain the maximum temperature (figure 12, page 21). Most of the weed seeds were apparently destroyed when the temperature stopped at 60°, although the legumes and Capsella were exceptions and probably there are other exceptions. Weeds found in the checks included Amaranthus, Anthemis, Barbarea, Capsella, Cerastium, Lamium, Oxalis, and Stellaria.[6] The data from these tests are summarized graphically in figure 5. A point of some interest is the apparent increase in damping-off of spinach and cucumber, and in the germination of weed seeds, by heating the soil to only 45°. Such treatment rendered conditions worse than in the checks, although there have not been a sufficient number of trials to warrant assuming this to be generally true. Substantiation of the idea that a final maximum temperature of 60° is sufficient for damping-off control is presented in figure 6, in which stands of cucumbers, tomatoes, and spinach are shown in soil heated to three temperatures as compared with an unheated check.

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[5] Hynes & Cox Electric Corporation, Albany, New York.

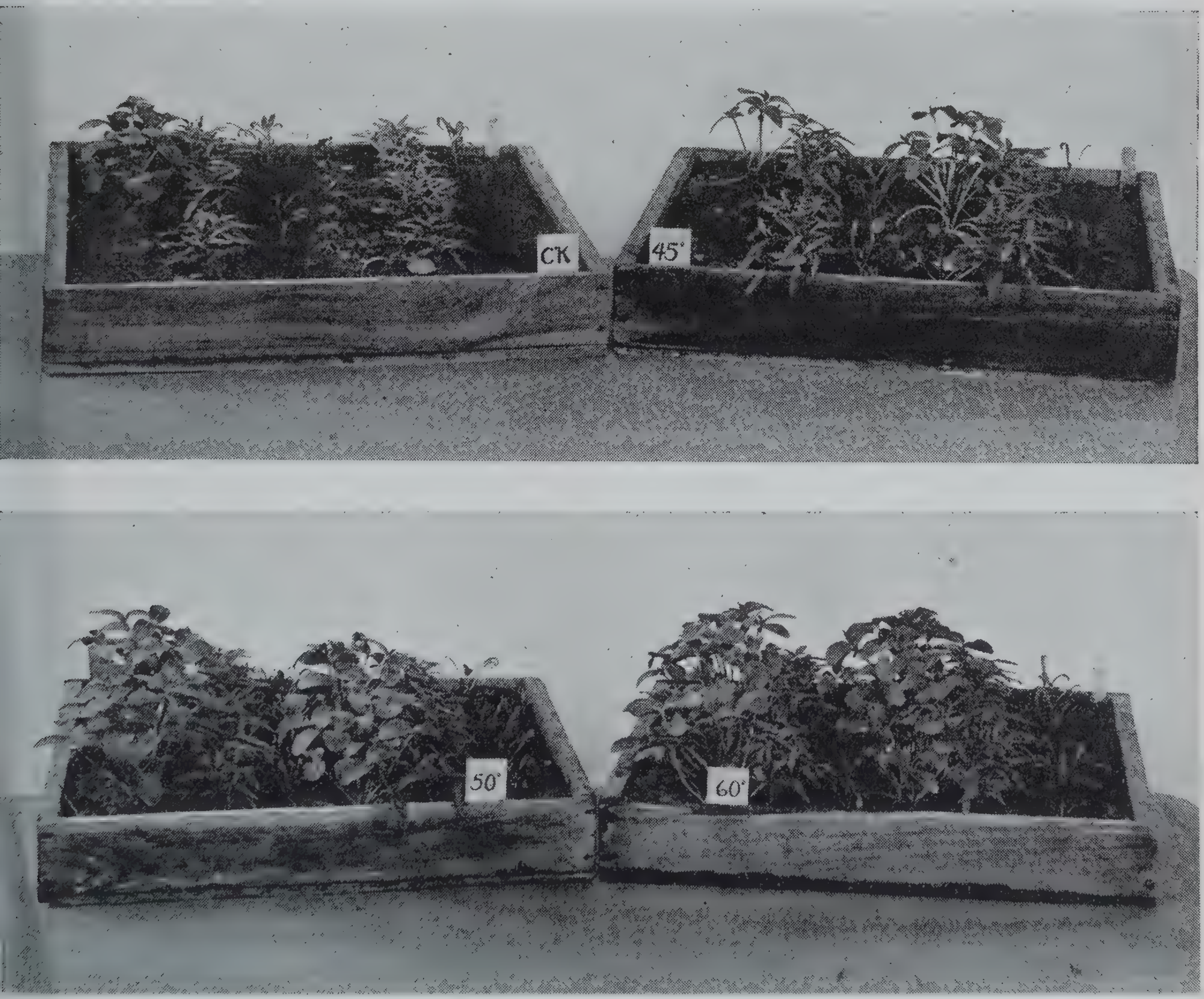

Figure 6. stands of replicate plantings of cucumbers, tomatoes, and spinach, in soils heated to the final maximum temperatures indicated (45°, 50°, and 60° c.) in the nixon dairy pasteurizer

No damping-off occurred in the soil heated to 60° C., though some was present in the samples brought to 50° and 55° C.

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[6] Identification of weeds was done by Professor W. C. Muenscher, of the Department of Botany at Cornell University.

Further confirmation of this important generalization, that effective soi treatment requires heating only to 60° C., is presented in the form of table of thermal death-points of a number of microorganisms, other tha bacteria, of variable pathogenicity (table 1). Examination of these dat show that few fungi can withstand 65° C. even for 10 minutes. Scleroti are no exception. Some of the molds which may be wet with difficulty ar more resistant. Turning for a moment to bacteria, Elliott (1930) give data on the thermal death-points of 102 bacterial plant pathogens, o which only 4 lie above 59° and none is above 69°.

TABLE 1. THERMAL DEATH-POINTS OF A NUMBER OF MICROORGANISMS OF VARIABLE PATHOGENICITY

Pathogen	Form	Temperature (C.)	Time (minutes)	Authority
Actinomyces scabies	Conidia	54°	10	Lutman and Cunningham (1914)
Alternaria solani	Conidia	45°	—	Rands (1917)
*Aspergillus niger**	Spores	55°	30	Wallace and Tanner (1931
Botrytis cinerea	Mycelium and spores	55°	15	Zumstein (1936)
Botrytis cinerea	Conidia	50°	10	Smith (1923)
Cercospora apii	Mycelium and spores	52°	10	Klotz (1923)
Cladosporium fulvum	Spores	70°	1	Bewley and Buddin (1921)
Colletotrichum lindemuthianum	Mycelium	50°–52°	10	Muncie (1917)
	Spores	46°–48°	10	Muncie (1917)
C. oligochaetum	Spores	60°	1	Bewley and Buddin (1921)
C. lini		50°	30	Vladimirskaya (1930)
Diaporthe batatatis	Conidia	48°–49°	10	Harter and Field (1913)
Ditylenchus dipsaci	Larvae	43.5°	46	Ramsbottom (1918)
D. dipsaci	Larvae	48.5°	15	Ramsbottom (1918)
D. dipsaci	Larvae	52.5°	11	Ramsbottom (1918)
D. dipsaci	Larvae	57.5°	5	Ramsbottom (1918)
Fusarium eumartii	Mycelium and spores	55°	15	Zumstein (1936)
F. lycopersici	Mycelium and spores	65°	10	Zumstein (1936)
F. moniliforme	Conidia	70°	10	Merrill (acc. Hartley, 1921:28)
F. oxysporum	Mycelium	58°–59°	5	Wood (1939)
Helminthosporium sativum	Mycelium and spores	54°	10	Christensen (1926)
Heterodera marioni	All stages	48°	10	Newhall (1930)
Macrosporium solani	Mycelium and spores	50°	5	Zumstein (1936)
Marssonina panattoniana	Conidia	40°	10	Brandes (1918)
Mucor species†	Conidia	57°	30	Thom and Ayers (1916)
*Oidium lactis**‡	Spores	60°	30	Wallace and Tanner (1931
Penicillium species§	Conidia	60°	30	Thom and Ayers (1916)
Phoma apiicola	Spores	49°	10	Bennett (1921)
Phytophthora citrophthora	Mycelium and zoospores	43.3°	5	Klotz (1940)
P. parasitica	Mycelium and spores	60°	1	Bewley and Buddin (1921)
P. cryptogea	Mycelium	50°	1	Bewley and Buddin (1921)
Plasmodiophora brassicae		60°	30	Vladimirskaya (1930)
Pythium debaryanum	Mycelium	40°	10	Zumstein (1936)
P. debaryanum	Mycelium and spores	65°	10	Merrill (acc. Hartley, 1921:28)
Rhizoctonia (=*Corticium centrifugum*)	Sclerotia in water	50°	50	Watanabe (1933)
C. centrifugum	Sclerotia in air	50°	60	Watanabe (1933)
C. centrifugum	Mycelium in water	45°	30	Watanabe (1933)
C. centrifugum	Mycelium in air	45°	20	Watanabe (1933)
Rhizoctonia crocorum	Mycelium	45°–48°	60	Newton (1931)
R. solani	Mycelium	45°–60°	60	Newton (1931)
R. solani	Sclerotia	55°–60°	60	Newton (1931)
Rhizopus nigricans	Spores	54.5°	30	Thom and Ayers (1916)
*R. nigricans**	Spores	50°	20	Wallace and Tanner (1931)
Sclerotinia sclerotiorum	Sclerotia	48°–50°	5	Joshi (1924)
S. delphinii	Sclerotia	50°	10	Zumstein (1936)
S. rolfsii	Sclerotia	50°	10	Zumstein (1936)
Septoria lycopersici	Spores	52°	10	Levin (1916)
S. apii	Mycelium	44°	10	Cochran (1932)
S. apii-graveolentis	Mycelium	42°	10	Cochran (1932)

*Suspended spores in dilute salt solution. Longer time sometimes needed in sugar solutions.
†Four species with thermal death-point below 57° C.
‡Survived 60° C. for 30 minutes. No survival at 62.8° according to Thom and Ayers (1916).
§Twenty-three species with thermal death-point below 60° C.

Valleau, Karraker, and Johnson (1926) found that heating soil to 65° C. for 15 minutes was sufficient to kill a Fusarium and a "Pythiumlike" organism causing root-rot of corn.

In studying the diseases of mushrooms, several workers recently have made pertinent observations on time-temperature conditions lethal to certain pathogens attacking this crop. Lambert (1930) found mycelium and chlamydospores of *Mycogone perniciosa*, the cause of "bubbles", to be killed in one hour at 50° C. and in six hours at 42° C.; artificially infested soil was rendered safe after a six-hour treatment at 45° C. Ware (1933) found that *Verticillium Malthousei* (brown spot) was killed in six hours at 40° C. Beach (1937) found that the following organisms did not survive soil temperatures fluctuating between 115° and 120° F. (46° and 49° C.) if such temperatures were maintained for sixteen to twenty-four hours: *Bacterium* sp. (brown blotch), *Cephalothecium* sp. (casing mold), *Dactylium* sp. (mildew), *Monilia fimicola* (white plaster mold), *Mycogone perniciosa* (bubbles), *Trichoderma koningi* (green mold), and *Verticillium* sp. (brown spot); spores of certain species of Penicillium and Aspergillus, however, survived six-hour exposures in a water bath at 140° F. (60° C.). Lambert (1932) reports that the spores of *Pseudobalsamia microspora* (truffle) survived 82° C. for five hours, and Beach found them to survive a 2-day heating in compost at 57° C. Beach concludes that 120° F. (49° C.) is sufficient to kill the more important harmful fungi in mushroom beds during the rather long period of heating attending the composting process, while 130° F. (54° C.) is preferable where insects must be driven out. This latter temperature, however, may be insufficient to kill *Pseudobalsamia microspora* (truffle), *Chaetomium olivaceum* (olive-green mold), and *Myriococcum praecox* (brown plaster mold) which are more resistant to heating.

Henrici (1930) mentioned the importance of moist heat as against dry heat in the destruction of molds. He stated that spores of *Monilia sitophila*, if wet, are killed in 5 minutes at 72° C., but if dry they require a 30-minute heating at 120° C. As the spores are not easily wetted, they may survive the baking process within a loaf of bread dough, where the temperature may not attain 100° C. Thom and Ayers (1916) also showed that in order to kill some molds dry heat must be twice as high as moist heat. Watanabe (1933) showed that whereas dry air aids in destroying mycelium of fungi, it hinders the destruction of resting organs such as sclerotia of Rhizoctonia.

Murphy and M'Kay (1926) showed that the perennial mycelium of *Peronospora destructor* in onion bulbs can be killed by heating the onions to 43° C. for a period of eight hours. Ramsbottom (1918) found that the eelworm *Ditylenchus dipsaci* (*Tylenchus dipsaci*) is destroyed by immersion of affected narcissus bulbs in water at 43.5° C. for two to four hours.

It is therefore the exception, rather than the rule, for fungus, nematode, and bacterial protoplasm to withstand temperatures between 60° and 65° C., even for a few minutes, under moist conditions. Since insect life also cannot withstand such temperatures and many of the most common plant viruses are destroyed in this range[7], and since most weed seeds are believed to be killed below these temperatures, the author chose 65° C. as the minimum end-point soil temperature to be sought in the experiments describe in the following pages.

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[7] Exceptions are some which occur in tobacco and tomato.

EXPERIMENTS WITH INDIRECT-SOIL-PASTEURIZING DEVICES

ATTEMPTS TO USE AN ORDINARY SOIL-HEATING CABLE

Even the most successful electric soil pasteurizers thus far designed hav the objectionable feature of requiring the soil to be handled once when i is put into the device, and again when it is removed to its permanent site This situation has led to a search for ways of treating soil in benches an ground beds, without the labor of moving it.

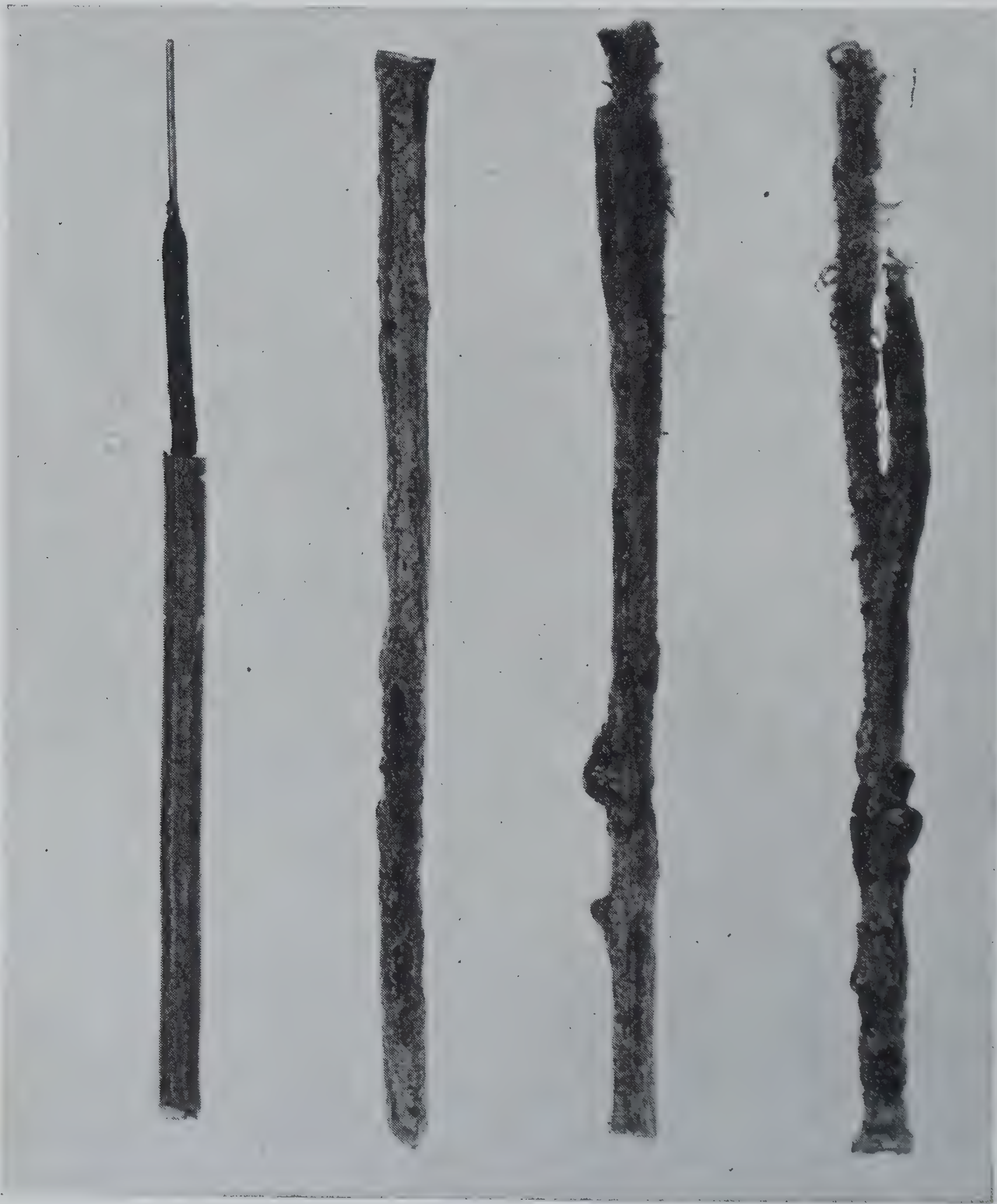

FIGURE 7. EFFECT OF HIGH TEMPERATURE ON LEAD-COVERED SOIL-HEATING CABLE

Left, normal condition of cable. Right, condition after a few hours of use in soil as a pasteurizing device, showing melted lead and injured insulation

A number of unsuccessful attempts have been made to pasteurize with a standard brand of lead-covered soil-heating cable, but this was not suited to withstand the high temperatures needed for this kind of work. What happens to such a cable when used in this way is illustrated in figure 7. In order to avoid melting of the lead sheath, it was necessary to use excessive quantities of the cable per unit volume of soil to obtain the necessary wattage required per cubic foot. The need for a cable that can be used for the dual purpose of soil-heating and -pasteurizing in coldframes, hotbeds, and cutting beds, has often been expressed by both growers and research men.

THE INDUCTION TYPE OF ELECTRIC GRID

One ingenious device for pasteurizing soil in ground beds makes use of the induction principle long employed in certain kinds of electric furnaces and in all transformers. It is essentially a set of iron pipes connected to form a grid somewhat resembling a short wide ladder. A few turns of nsulated copper wire are drawn through certain members of the grid, and when alternating current is passed through these coils circulating currents are induced in the iron pipes surrounding them just as in the secondary windings of a transformer. Because of the resistance of the iron pipes, a considerable degree of heat is generated in them.

Two such units have been made by engineers of the Rochester Gas & Electric Corporation, of Rochester, New York, and have been used successfully for a short time in greenhouse soil pasteurization. Since the insulation on the primary wires is subject to high temperatures and a considerable amount of moisture when buried in the soil, it must be carefully selected if durable units are to be obtained. Certain construction difficulties also are met with in assembling this device, but these probably are not insurmountable.

A table giving some of the characteristics of these grid heaters has been prepared by H. A. Brown, of the Rochester Gas & Electric Corporation, and is presented here with Mr. Brown's permission (table 2). The design "A" called for a grid 40 inches long, with eight cross members 6 inches apart and having a heat flux of a little more than 2.5 watts per square inch of pipe surface, the pipe size to be 1 inch. The design "B" was to be 10 eet long, and was to contain only six cross members but with the same heat lux. The heaters were to be used on 115-volt alternating current, and would treat, when buried in the ground, approximately 14 and 30 square feet of bed space, respectively. From the table it is seen that the design chosen or the shorter grid, "A_5", called for 11 turns of no. 12 black waterproofed asbestos-covered copper wire in each of the four loops of the grid, and would have a connected load of 4.2 kilowatts and 41 amperes. The design chosen for the longer grid, "B_6", called for 5 turns of no. 12 wire of the same description in each of the three loops, and would have a load of about 8.4 kilowatts and 79 amperes.

The cost of construction of such grids was rather high, owing to the many threaded elbows. Estimates for materials alone have been placed at approximately $25 for each grid, and the labor is a large item. At present, therefore, further development of the induction type of portable soil pasteurizer does not seem very promising.

TABLE 2. SOME CHARACTERISTICS OF AN INDUCTION HEATING TYPE OF SOIL-PASTEURIZING GRID MADE OF 1-INCH IRON PIPE FOR 60-CYCLE ALTERNATING CURRENT*

Pipe arrangement†	Copper-wire B. & S. gauge	Number of turns	Current in circuit (amperes)	Copper loss (watts)	Iron loss (watts)	Total loss (watts)	Watts per square inch of pipe surface	Voltage on line
A$_1$	22	4	40	664	3,208	3,872	2.50	97.1
A$_2$	14	10	40	1,236	2,636	3,872	2.50	106.0
A$_3$	12	12	40	952	3,872	4,824	3.12	136.0
A$_4$	12	12	33.9	684	2,776	3,460	2.23	115.0
A$_5$‡	**12**	**11**	**41.1**	**916**	**3,264**	**4,180**	**2.70**	**115.0**
A$_6$	10	11	43.7	656	3,700	4,356	2.81	115.0
A$_7$	10	12	37.2	520	3,180	3,700	2.39	115.0
A$_8$	14	11	36.4	1,148	2,656	3,804	2.46	115.0
B$_1$	6	5	102.8	1,323	8,979	10,302	3.27	115.0
B$_2$	6	6	74.8	828	6,507	7,335	2.33	115.0
B$_3$	8	5	98.1	1,917	7,896	9,813	3.12	115.0
B$_4$	8	6	73.2	1,281	5,976	7,257	2.31	115.0
B$_5$	10	5	92.9	2,733	6,834	9,567	3.04	115.0
B$_6$‡	**12**	**5**	**78.7**	**3,120**	**5,256**	**8,376**	**2.66**	**115.0**

*Prepared by H. A. Brown, of the Rochester Gas & Electric Corporation, Rochester, New York.

†Pipe arrangement: A = 4 loops 40 inches long spaced 6 inches connected in series.
B = 3 loops 10 feet long spaced 6 inches connected in series.

‡Design chosen for experimental models.

BURIED ELECTRIC PIPE-TYPE HEATERS

In the interests of safety and economy, buried pipe-type heaters were tested in benches and ground beds as a substitute for vertical plates and the direct-heating methods already tested by some other investigators—as Dix and Rauterberg (1933), Krewatch and Kable (1933), and Fee (1933). With such heaters, many of the objections to the direct method are eliminated at the start. No transformer is necessary. There are no leakage to the ground, no danger to the operator, and no troublesome contact difficulties between electrode and soil. The demand can be accurately determined before starting, and it does not fluctuate from one test run to another.

Tests in greenhouse bench soil

A series of six pipe-type heaters (Hynes & Cox), of ¾-inch galvanized pipe 40 inches long, each heater rated at 400 watts on 230-volt alternating current, was set up in a bench as illustrated in figure 8. The heaters were spaced 7 inches apart, 3½ and 2¼ inches from the top and the bottom of the bench respectively, which empirical setting proved to be satisfactory. By way of comparison with similar heaters already on the market, a set of two General Electric Calrod soil-sterilizing units was placed in another compartment of the bench beside the first. These Calrod heaters had a combined rating of 1500 watts, while that of the six pipe-type Hynes & Cox heaters totaled 2400 watts. Each of the two bench compartments was 5¾ inches deep and contained approximately 5½ cubic feet of soil, thus giving a wattage per cubic foot of 273 and 436, respectively, in the two compartments. The current employed was 230-volt alternating current.

Seven test runs were completed with this equipment, the object being t determine the current consumed by each unit in raising all parts of th soil from room temperature to at least 60° C. Temperatures were meas ured by a set of 20 thermometers placed carefully and read at regular intervals. Three kinds of soil were employed—sand, loam, and muck. The results are summarized in table 3. It is seen that the efficiency of the two kinds of heaters was not significantly different. The time requirements were in proportion to their current rating, the higher-rating outfit carrying the soil up to a proportionately higher mean temperature in the same number of hours. Sand was the most economically treated of the three kinds of soil.

TABLE 3. Summary of Test Data on Electricity Consumption with Two Kinds of Heaters in Bench Soil of Three Types

Type of soil	Mean temperature rise in three hours (centigrade)		Mean watt-hours per degree rise per cubic foot of soil		Mean kilowatt-hours per 50 degrees rise per cubic foot of soil	
	Hynes & Cox	General Electric	Hynes & Cox	General Electric	Hynes & Cox	General Electric
Sand	59°	40°	22		1.121	
Sand	57°	38°		21		1.068
Loam	52°	39°	27		1.349	
Loam	64°*	39°*		35†		1.759†
Muck	37°	34°	34		1.711	
Muck	51°*	38°*		28		1.417
Muck	37°*	35°*	32		1.612	
Mean	51.0°	37.1	28.8	28.0	1.448	1.411

*Four-hour instead of three-hour periods.

†It is believed that excessive soil moisture may have been responsible for this rather high figure.

A feature of the equipment which was of value in keeping the heat loss down to a minimum, was a 1-inch layer of composition insulating board laid on top of the soil while the heating was in progress (figure 8).

It is thus possible to equip shallow benches with electric heating devices that will adequately and safely pasteurize all kinds of soil on 230-volt current with consumption of approximately 1.5 kilowatt-hours per cubic foot of soil. Considerable variation in the wattage per cubic foot of soil is shown by these tests to be quite permissible if the soil is kept covered. It is admitted, however, that at present the expense of the equipment and the time consumed in handling it do not recommend it as a method of practical value. The equipment for these tests costs approximately $25, and in each case it pasteurized but 5 or 6 cubic feet of soil in three to four hours time.

Some time after the completion of these experiments, a small portable soil sterilizer, employing one 750-watt Calrod unit like the one referred to above, was placed on the market. It is shaped and may be carried like a large suitcase, holds a little more than 2 bushels of soil, operates on 115-volt alternating current, and will pasteurize a charge of soil in four to five hours. The one illustrated in figure 9 has been in use at the entomology greenhouses of Cornell University for several months.

Tests in greenhouse ground beds

To determine the time and the current required to pasteurize soil in a ground bed 10 to 12 inches deep with the above-described portable pipe-type heaters, a set of six, each 40 inches long and of 400-watt rating, was

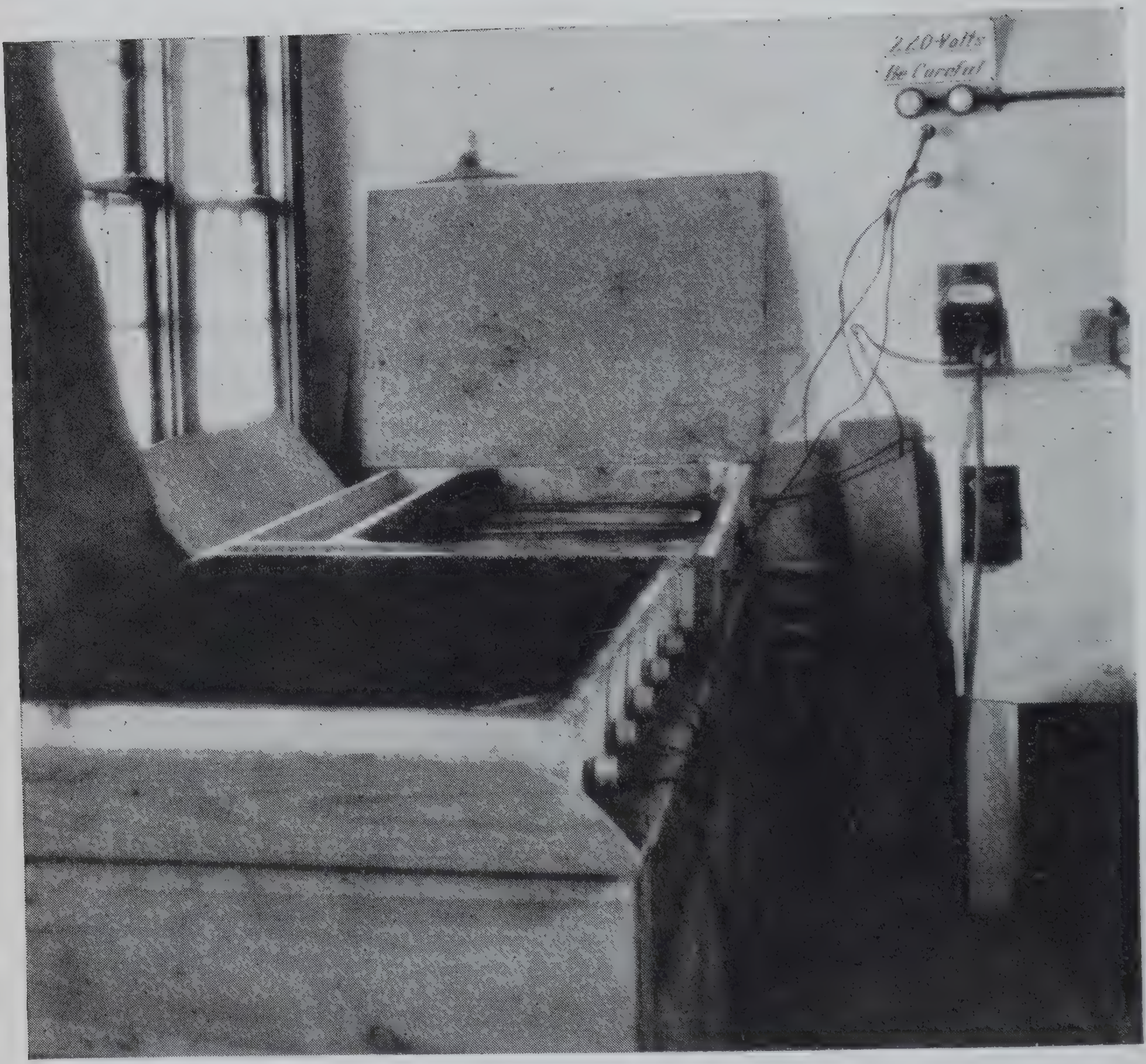

FIGURE 8. A COMPARISON OF TWO KINDS OF SPACE HEATERS IN BENCH SOIL 5¾ INCHES DEEP

The composition insulating board at side and rear is used for covering the soil

buried, the heaters being placed in parallel rows, 7 inches deep and 7 to 8 inches apart. In order to avoid danger of short circuits, watertight right-angled conduit fittings, with short nipples through which the connecting wires could be led above ground, were attached to the ends of each heater (figure 10).

The test plot measured 46 inches wide by 18 feet long, and was heavily infested with *Phytophthora parasitica*. Six changes of position of the heaters, allowing a 3-inch overlap, were sufficient to treat the bed. A period of six to eight hours was required to bring all parts of the soil mass occupied by the heaters up to a minimum pasteurizing temperature to a depth of 11 inches. The total current consumed in thus pasteurizing 10 cubic feet of soil was from 12.2 to nearly 20 kilowatt-hours, depending upon the moisture content of the soil which was purposely altered at times. The results are summarized in table 4. It is seen that as the moisture was increased from 18.8 to 24.7 per cent, the current consumption went up from 26.9 to 44.2 watts per degree rise per cubic foot. Tests made by growing

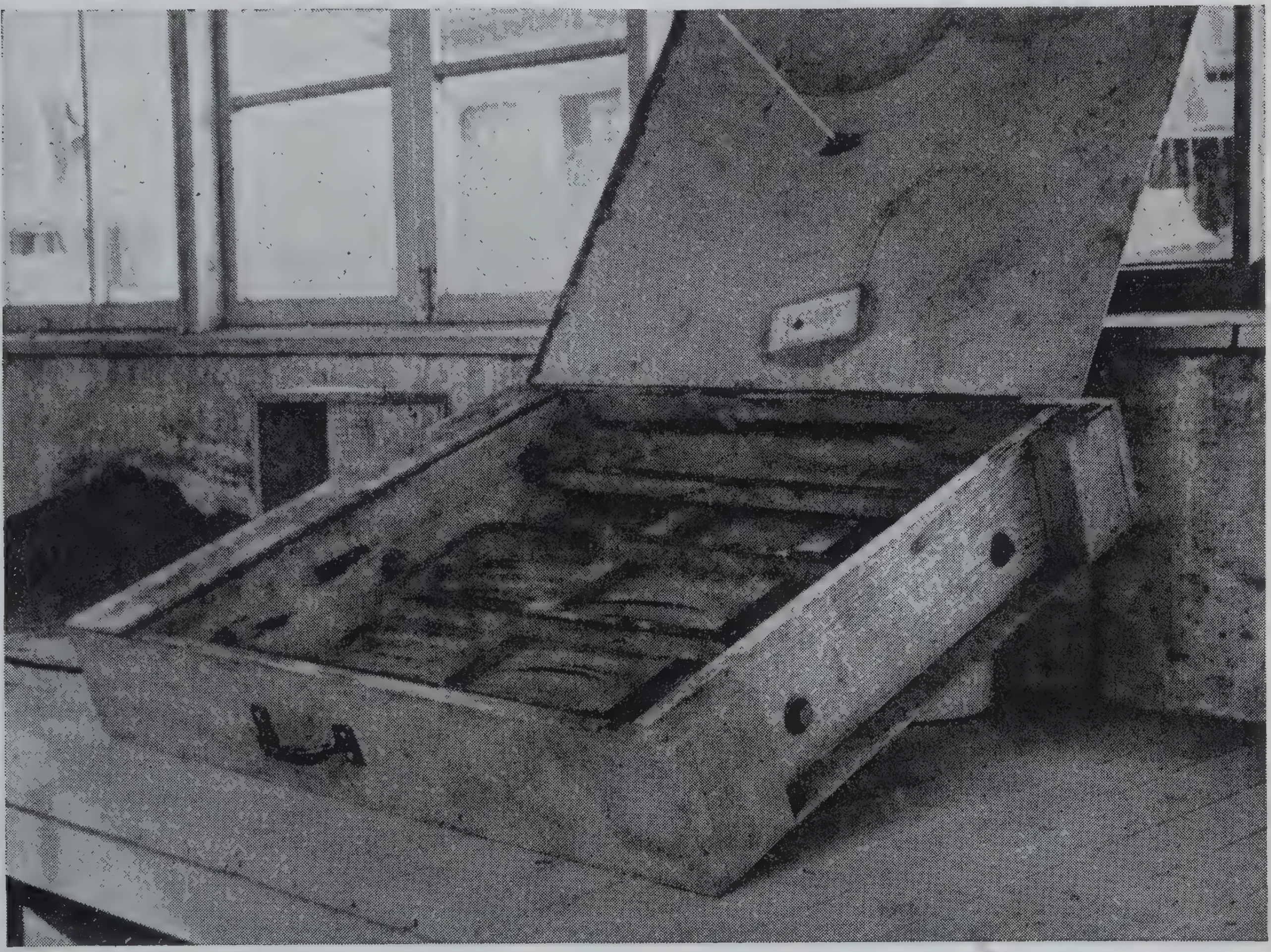

Figure 9. A PORTABLE PASTEURIZER FOR 115-VOLT ALTERNATING CURRENT, HOLDING BETWEEN 2 AND 3 BUSHELS OF SOIL. COMPARE WITH FIGURE 8

tobacco plants in treated and in untreated soil indicated that complete control of the Phytophthora disease was obtained by the treatment given to this ground bed.

TABLE 4. Summary of Current Used in Pasteurizing a Ground Bed of Loam with a Set of Six Portable Pipe-Type Space Heaters Buried 7 Inches Deep

Test run no.	Mean soil moisture (per cent)	Mean watt-hours per degree rise per cubic foot of soil	Mean kilowatt-hours per 50 degrees rise per cubic foot of soil
6	18.0	26.4	1.320
4	18.8	26.9	1.345
3	19.0	28.3	1.415
5	19.4	31.9	1.599
1	21.0	35.0	1.752
2	24.7	44.2	2.209
Mean	20.28	32.08	1.606

A demonstration of the importance of soil moisture was made by moistening one half of one test plot more than the other half, and noting the difference in mean-temperature readings of the soil in both halves at the end of the seven-hour heating period. On one side the moisture was 18.88 per cent at the start, and on the other side it was 22.05 per cent. At the end of the period the mean-temperature rise of the soil in the drier side was 48.6 degrees centigrade while that of the soil in the wetter side was but

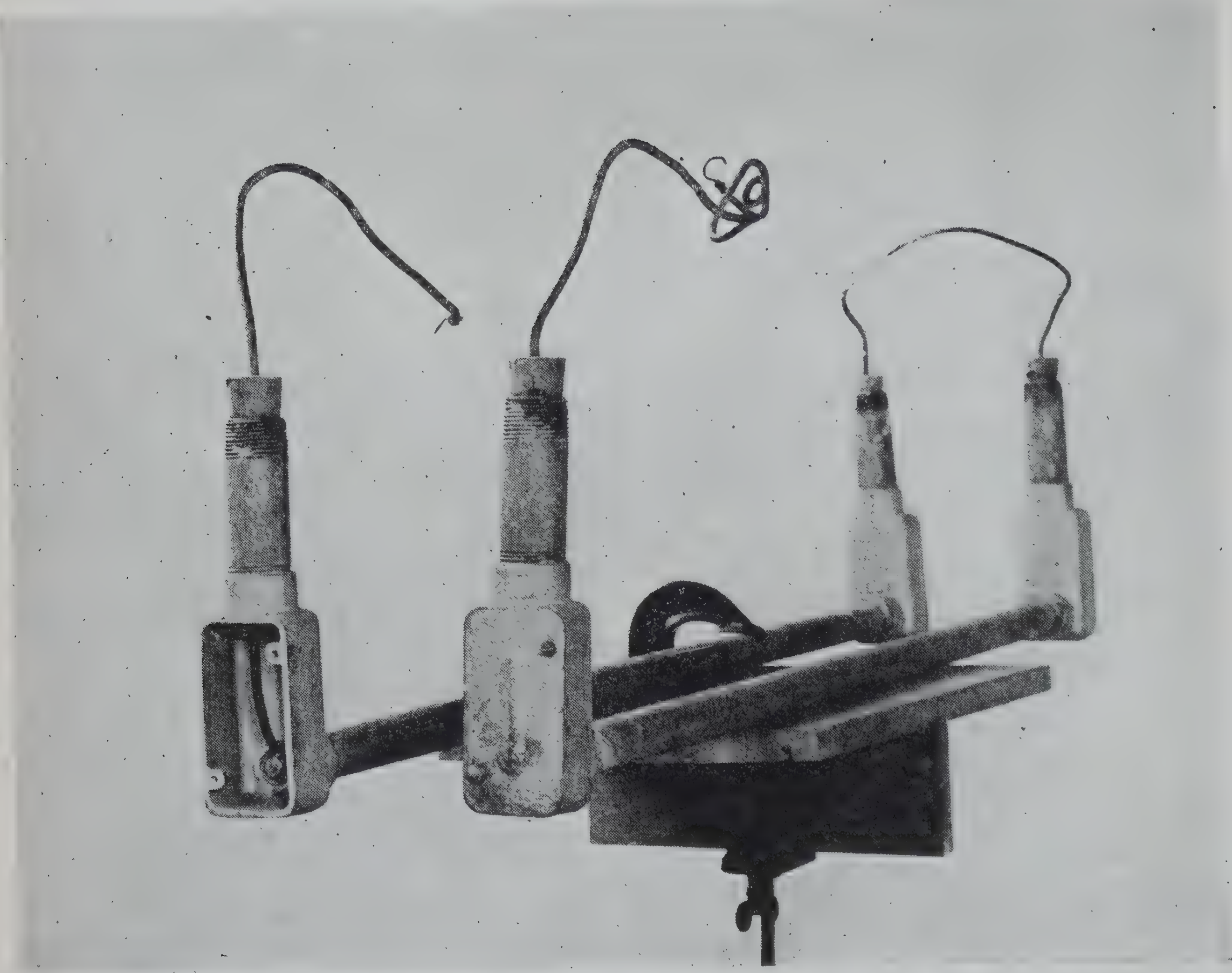

FIGURE 10. A PAIR OF 40-INCH PIPE-TYPE HEATERS, EACH RATING 400 WATTS, SHOWING THE WATERTIGHT CONDUIT FITTINGS AND NIPPLES EMPLOYED ON THE ENDS TO PERMIT SAFE BURIAL AND USE IN MOIST SOIL

42.7 degrees, or 12 per cent lower. In other words, a 14-per-cent-lower initial soil moisture resulted in a 13.8-per-cent-higher mean-temperature rise by the end of the heating period. Similarly, a comparison of test run no. 4 with test run no. 2, in table 4, shows that it required 64 per cent more current to overcome a 31-per-cent difference in initial moisture content of the soil.

TYPES OF ELECTRIC SOIL PASTEURIZERS GENERATING STEAM

Since it appeared that little more could be gained by further experimenting with types of electric heaters that must be buried, dug up, and reset at frequent intervals, attention was turned to the possibility of generating steam with electric heating units close to the soil but not buried in it. That this apparently has not been tried before would seem to be owing to the beliefs (1) that steam must enter the soil under pressure in order to be effective, and (2) that electrical energy is too expensive relatively to other ways of generating steam. Both these ideas evidently need revising.

The author (Newhall, 1930) has reported satisfactory steaming operations, employing the inverted pan, in which good results in eradicating nematodes in ground beds and benches were obtained with steam under less than 12 pounds pressure on the boiler, even when the boiler was 100 feet from the scene of operation. Under such conditions the pressure under the pan itself may be practically nil. Furthermore, on theoretical grounds it is obvious that there is little need for much pressure to drive steam into the soil if one considers the process of heat transfer when the steam enters the soil. In contacting a cold surface, as a particle of soil, the steam is chilled to the point of condensing, and so gives up most of its heat to the soil particle. At the same time its own volume is reduced to a very small fraction of what it was formerly (less than 1/1500). This great reduction in volume enables the steam to pass through the soil, condensing as it passes and releasing its heat, without filling and clogging the open spaces between the soil particles. It therefore takes an almost negligible pressure to drive steam into loose soil which is not already soaking wet.

The importance of having the soil loose, as pointed out by the author (Newhall, 1927), needs no further comment; but the importance of not having it wet can be better understood when one remembers that the specific heat of soil on a weight basis is only from 0.19 to 0.26 that of water, or from 0.44 to 0.57 on a volume basis according to Bouyoucos (1913). A pound of excess water therefore requires 4 or 5 times as many heat units as does a pound of soil, to elevate it to pasteurizing temperatures. Soil should not be too dry (powdery), however, since conduction of heat from one particle to the next can take place better through a thin film of moisture than through a dry air space. With ordinary soil the best results may be expected when the soil barely retains its shape after being squeezed firmly in the hand, rather than crumbling to pieces easily.

The Nixon dairy-utensil sterilizer

The first apparatus tested which employs this principle of steam-heating under atmospheric pressure was designed by M. W. Nixon, of Ithaca, for sterilizing dairy utensils. It has been briefly described by the author (Newhall, 1939, a and b). The steam is generated by a 1500-watt electric hot-plate built into the base of a tight, well-insulated cabinet having one large door in front (figure 11)[8]. The inside measurements in the experimental model employed are; height, 29 inches; width, 28 inches; depth, 15 inches. In the center of the bottom over the hot-plate, and as an integral part of the latter, is a metal pan holding 5 quarts of water which can be brought to a boil in 30 minutes. The device is rated for a 230-volt alternating current. The pan and the heating element are thoroughly insulated with rock wool; and a heat fuse and a time switch are connected in series with the heater, the former to melt in case the water should boil away before the time switch has opened the circuit. Some readers may recognize the similarity between this device and the old Arnold laboratory sterilizer familiar in bacteriology laboratories.

The soil is placed in flats, or trays, piled one above another in the cabinet —which, though having a total capacity of 7 cubic feet, actually holds a net total of only 2½ cubic feet of soil when the soil is in flats 3 inches deep with ¾ inch between the flats. The current is usually left on for nearly two and one-half hours, during which time approximately 3 quarts of water is boiled away and a soil temperature of 60° to 70° C. (140° to 158° F.) is attained. The soil-moisture content is increased by less than 10 per

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[8] Now manufactured by the Victor Dairy Products Company, of Hagerstown, Maryland.

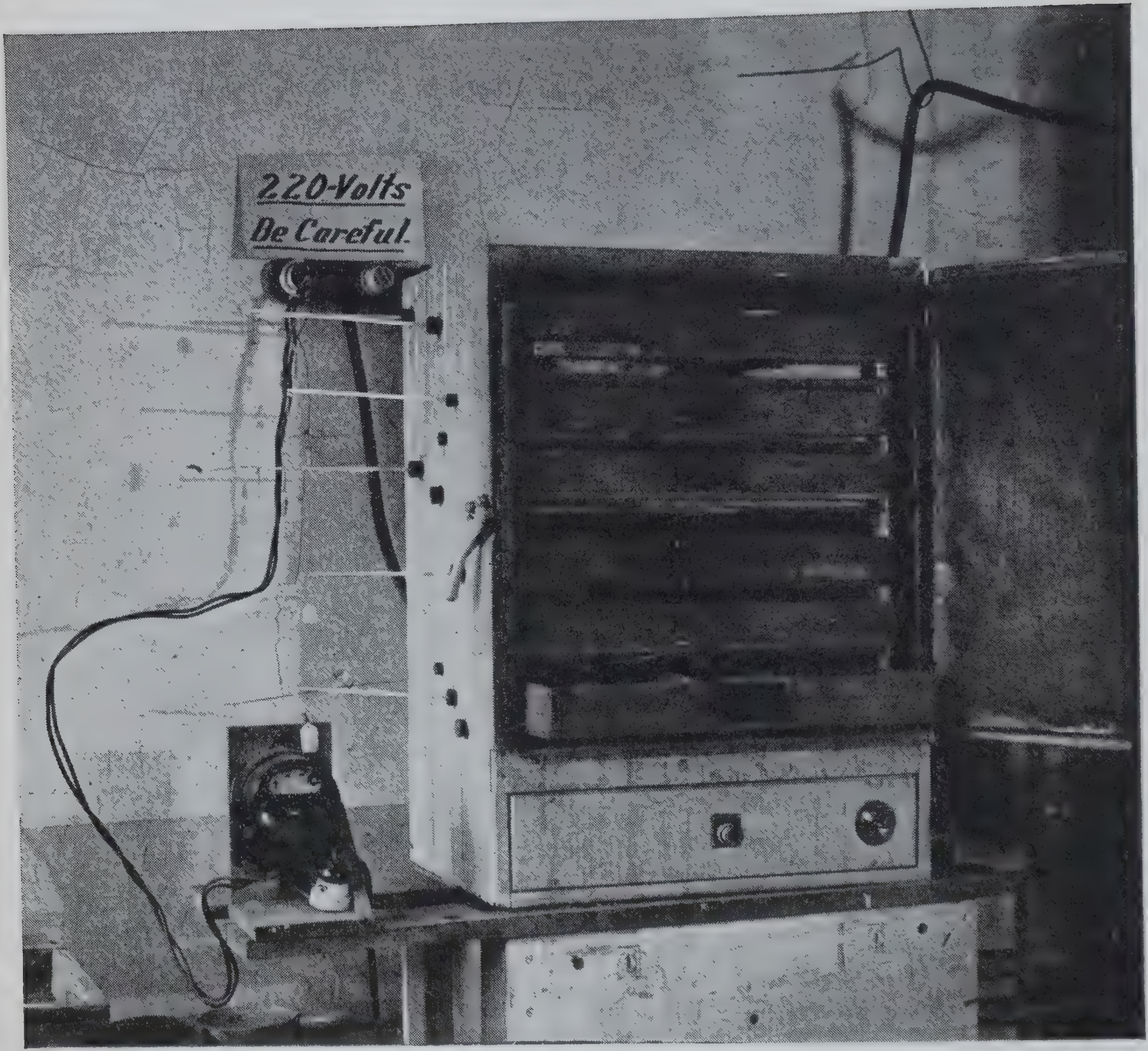

FIGURE 11. THE NIXON ELECTRIC DAIRY-UTENSIL STERILIZER, EXPERIMENTAL MODEL, USED IN MORE THAN 250 TEST RUNS WITH SOIL OF DIFFERENT KINDS, MOISTURE CONTENTS, DEPTHS, AND ARRANGEMENTS

The photograph shows the heat fuse and the time switch in the baseboard

cent, and is practically negligible if the flats are removed while still hot, since they lose much of their moisture while cooling.

In order to determine the conditions under which maximum efficiency could be obtained with this type of pasteurizer, a number of factors were studied in a series of more than 250 test runs[9]. A typical time-temperature curve for a nine-hour period during which the current was on for the first two and one-half hours (figure 12), shows the lag between soil and air temperature, the normal rise in soil temperature of several degrees after the current has been cut off, and the slow cooling reminiscent of the behavior of fireless cookers. As a rule, when the air temperature in the upper corner of the cabinet reached 80° to 85° C., the soil temperature was close to 60° and would advance up to 65° in the next half-hour on the latent heat stored in the heating elements. At the end of this period the soil could be removed, and it could be used as soon as it was cool enough.

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[9] Acknowledgment is made of the valuable assistance given by Herbert Roth in collecting much of the data used here.

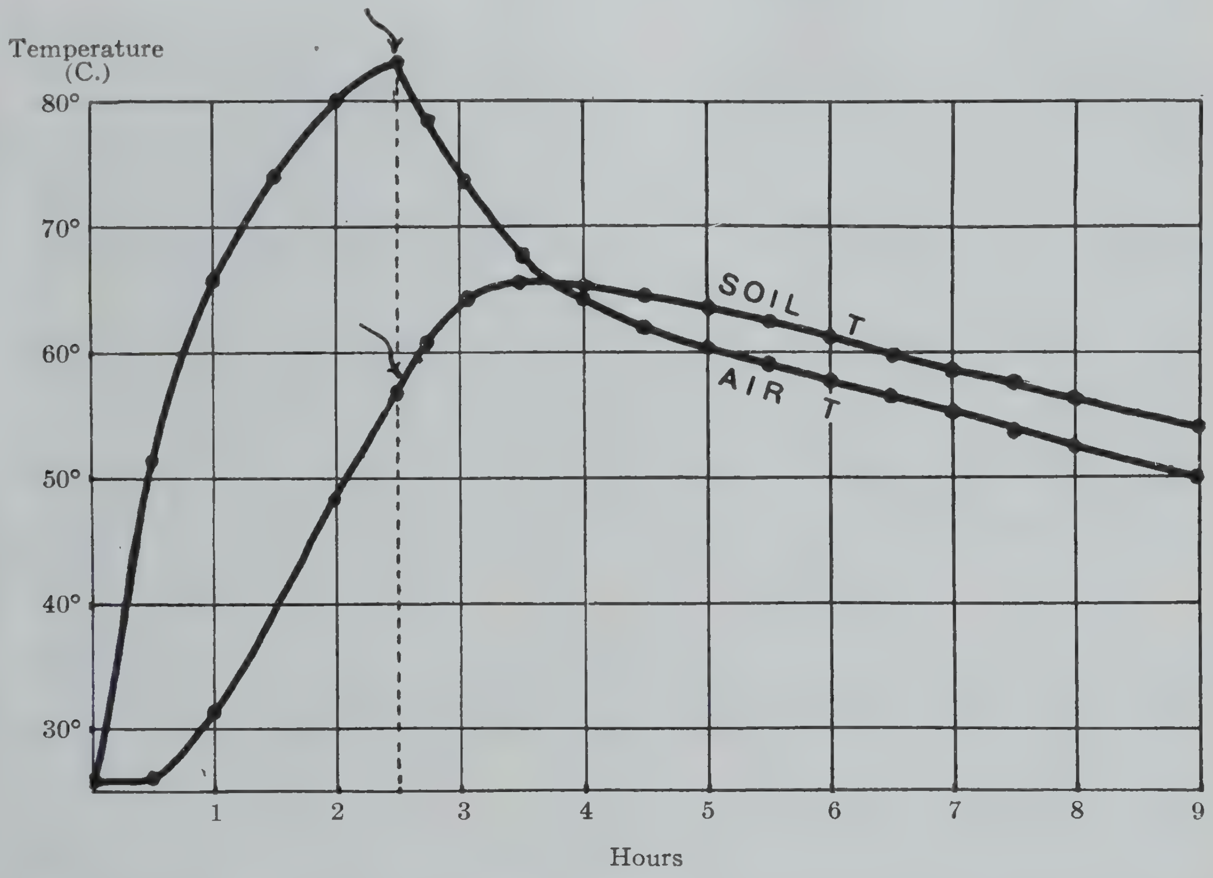


FIGURE 12. A TYPICAL TIME-TEMPERATURE CURVE OBTAINED WITH THE NIXON PASTEURIZER OVER A NINE-HOUR PERIOD WITH THE CURRENT ON FOR THE FIRST TWO AND ONE-HALF HOURS

The relation of the air temperature to the soil temperature, the rise of the soil temperature during the hour following disconnection of the current, and the slow cooling rate of the soil are evident in the graph

The role of initial soil moisture

A comparison of the time-temperature curves of two samples of loam soil, with initial moistures of 9.4 per cent and 21.3 per cent, respectively, will serve to illustrate the importance of soil moisture in determining the current consumed and the time needed to reach a given temperature with loam soil. Such a comparison is shown in figure 13. It required nearly an hour longer to heat the wetter soil up to 65° than to heat the drier soil to that temperature.

Effect of varying the soil depth

The question whether the same volume of soil, in this case 2½ cubic feet, can be heated more economically if spread out in a number of comparatively thin layers rather than in fewer but deeper layers, was answered in the affirmative by tests the results of which are summarized in figure 14. The deeper the flats of soil, the longer is the heating period required to reach any given temperature. For example, soil 3¾ inches deep reached 65° C. in one and three-quarter hours of heating, while soil 5½ inches deep reached only 54°, and soil 9½ inches deep reached only 43°, in the same length of time. Muck soil, with its higher moisture content, was particularly affected by this depth factor.

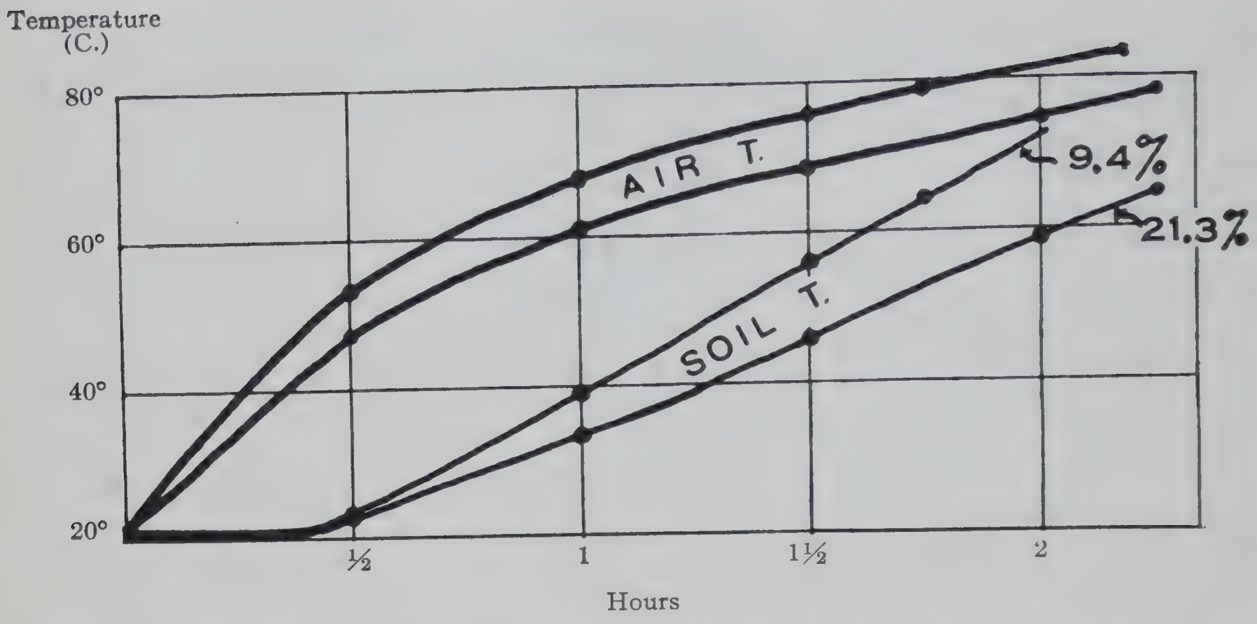


FIGURE 13. EFFECT OF TWO DIFFERENT INITIAL SOIL MOISTURES ON THE TIME REQUIRED TO ELEVATE SOIL TO 65° C. IN THE NIXON PASTEURIZER, AND ON THE RELATIONS OF THE AIR TEMPERATURE IN THE CABINET TO THE SOIL TEMPERATURE

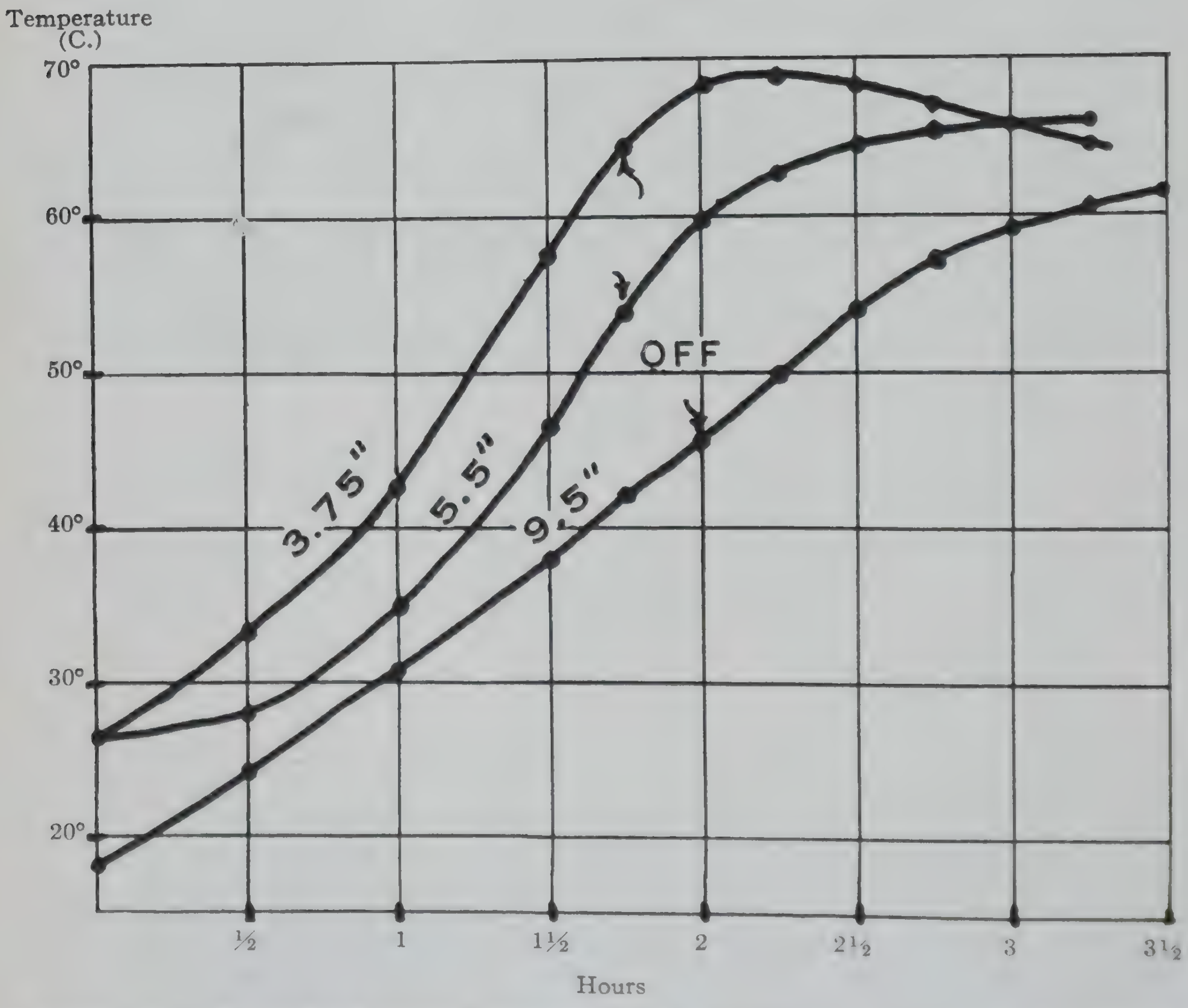


FIGURE 14. EFFECT OF THREE DIFFERENT SOIL DEPTHS ON THE TIME REQUIRED TO RAISE THE TEMPERATURE OF 2½ CUBIC FEET OF LOAM SOIL TO 65° C. IN THE NIXON PASTEURIZER

The current was on during the first one and three-quarters to two hours

Effect of varying the soil volume

Another factor that has a bearing on the general efficiency of the pasteurizer in question, is the ratio of soil volume to size of the heating element. No attempt was made to try different-sized heating elements; but by varying the volume of the soil and keeping records of the current consumed per cubic foot of soil per 50° C. rise in temperature, there was found to be a relation between volume and current consumption, indicating that greater efficiency was obtained when the cabinet was filled to capacity (2½ cubic feet) than when it was only half filled. The latent heat-absorbing capacity of the heater itself has a bearing on this. The time required to attain a given temperature was almost directly proportional to the volume of soil being heated. Both these relationships are summarized in figure 15. There is some indication from this that the 1500-watt heater employed could be used in a cabinet of still larger size than this one.

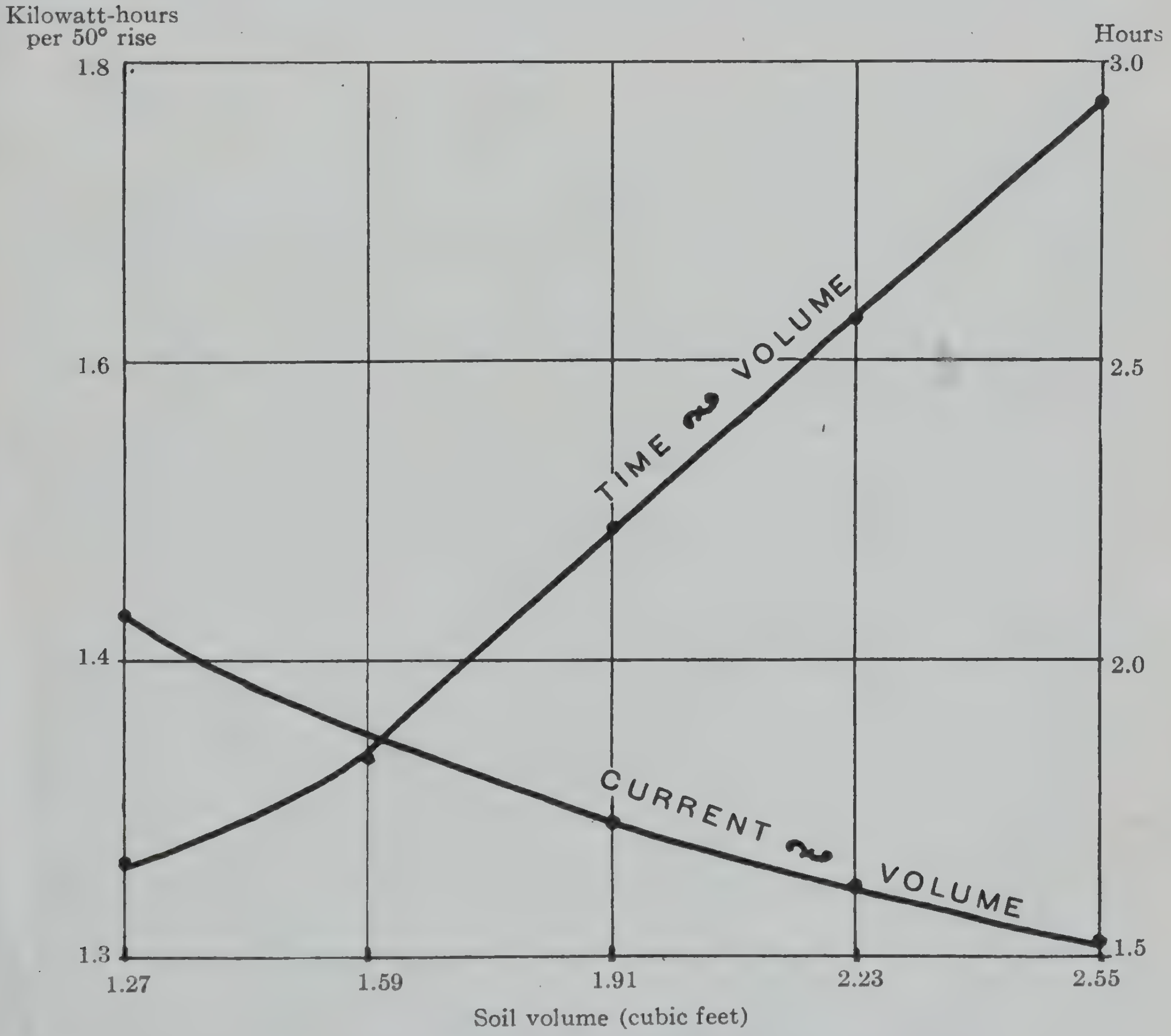


Figure 15. effect of increasing the volume of soil treated, on the time required for the soil to reach 65° C. and on the current required per cubic foot of soil

Effect of other miscellaneous factors

Mention has already been made of the latent, or stored, heat in the heaters that could be relied on to raise the soil temperature another 5 to 8 degrees in less than an hour after the current has been turned off. It must be obvious from this, that the greatest efficiency is attained by continuous operation, one charge of soil following another.

A study of efficiency in relation to a loose as compared with a compact condition of the soil in the trays, revealed little difference in the case of sand but a measurable difference with muck. By packing the muck in the trays a considerably larger amount could be put in, which increased the load by just that much.

Arrangement of the flats in the cabinet with respect to clearance around the edges and between them, was of importance in permitting easy access and free circulation of the steam. A clearance of 1 inch all around is believed to be the most satisfactory. Leaving an open space resembling a chimney up through the center was of little benefit. Greater efficiency was obtained when that space was filled with soil.

Alternate periods of heating, in which the current was turned on for 10 minutes at a time and off for 10 minutes, only seemed to increase the time required for the soil to reach 65° C., without decreasing the current consumption.

The temperature of the water at the start was of less importance than might be supposed at first thought. Very little was gained in efficiency by starting with hot water (82° C.) as against water at room temperature. The reason is apparent from a consideration of the following facts. The heat required to raise 1 pound of water through 1 degree Fahrenheit is, by definition, 1 B.T.U. In 3½ quarts there are 7.3 pounds, so that 1036 B.T.U. are required to raise that amount of water from room temperature (21° C.) to the boiling point (100° C.). But to convert 7.3 pounds of water to steam after it has reached the boiling point requires another 970.4 B.T.U.×7.3, or 7084 B.T.U. From this it is evident that heating the water up to the boiling point takes only about one-seventh of the total energy consumed in the entire operation. Incidentally, this also shows why a pound of water converted into steam is so much more effective than a pound of boiling hot water, in treating soils.

Mean current consumed per cubic foot of soil

Summarizing 150 of the test runs made with the Nixon pasteurizer, the current required to raise 1 cubic foot of soil to a temperature of 65° C. from an original temperature of 15° was found to lie between 1.15 and 1.68 kilowatt-hours for sand (mean 1.34, or 27 watts per degree), between 1.16 and 1.62 kilowatt-hours for loam (mean 1.39, or 28 watts per degree), and between 1.54 and 2.05 kilowatt-hours for muck, with its higher moisture content (mean 1.78, or 35 watts per degree). The variations observed between tests of any one kind of soil are due largely to variable soil-moisture content, soil depth, degree of soil compactness, and initial temperature of the heater. There is no significant difference in requirements between sand and loam, but the greater current consumption of muck as compared with the other two kinds of soil is highly significant statistically and is believed to be due to the greater proportion of water in the muck.

Some considerations relative to specifications for a larger model

In considering the construction of a larger pasteurizer capable of treating twenty-five flats at a time instead of six, a question arises as to how tall such a pasteurizer could safely be built without sacrificing efficiency.

While no tests were run, the impression was gained that disappointing results might be obtained if the pasteurizer were much more than 3 or 4 feet high, as there might be too great a difference in temperature between the top and the bottom flat at any given time. These variations were usually of only a few minutes duration in the cabinet under test, but, as they sometimes amounted to 10 or 15 degrees centigrade, they suggest that it might be better to enlarge in a horizontal rather than in a vertical plane.

A larger cabinet, capable of holding twenty-five flats 12 by 24 by 3½ inches in size, or nearly 15 cubic feet of soil (net), would require six 1500-watt heaters with a connected load of 9 kilowatts on 230 volts, or approximately 50 amperes. This is based on a rating of 600 watts per cubic foot of soil. To allow for circulation and space to be taken by the flats themselves would require a volume close to 45 cubic feet, which could be supplied by a cabinet with inside dimensions as follows: height, 30 inches; width, 7 feet 8 inches; depth, 28 inches. A lower wattage rating per cubic foot may be adequate.

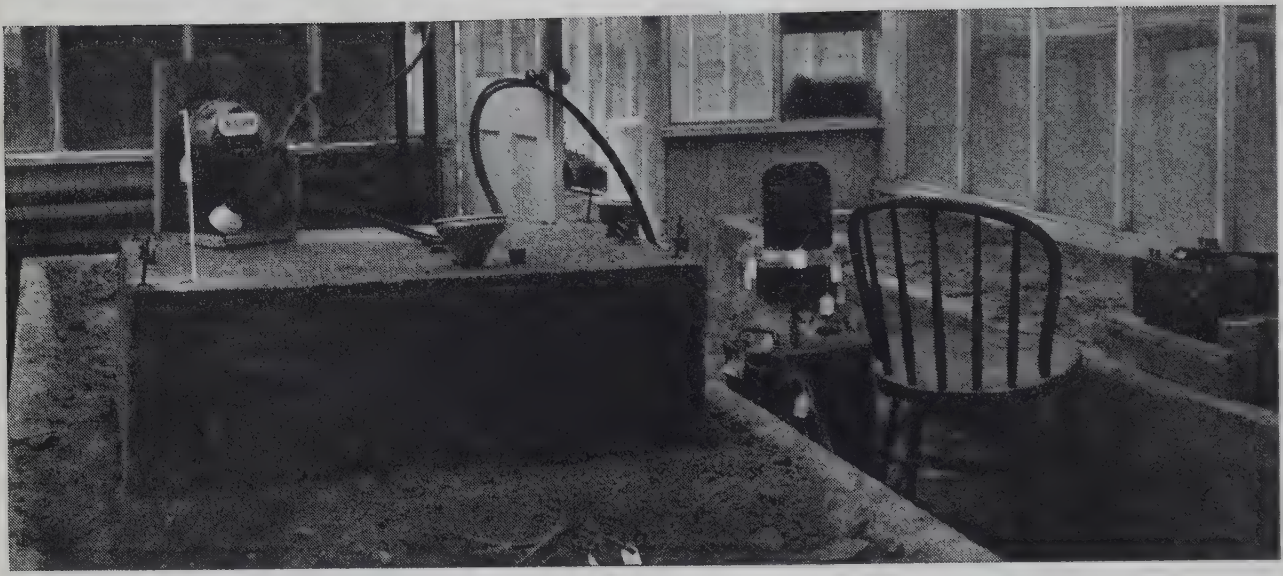
The Cornell electric inverted steam pan

The success obtained with the Nixon dairy-utensil sterilizer as a soil pasteurizer prompted the construction of a portable device, briefly described by the author in an earlier publication (Newhall, 1939 b), for use on greenhouse benches, ground beds, coldframes, hotbeds, and cutting beds. This is essentially an inverted pan similar to those long in use by greenhouse growers. But instead of steam being piped to it from a distant boiler, a 230-volt alternating current is brought to the pan and the steam is generated beneath in troughs of water heated by strap heaters (figure 16).

The experimental model was made of 1-inch insulating board over a light wooden frame. Its dimensions were 2½ feet wide by 3 feet long by 1 foot high. A 2-inch strip of galvanized iron around the lower edges helped to seal the edges when the pan was pushed down on the soil. The four metal water reservoirs inside held approximately 5 quarts of water each, and they were filled through stoppered holes in the top. The four 1500-watt heaters were wired in parallel; so that a constant demand of 6 kilowatts was employed to steam 7½ square feet of soil, which was accomplished to a depth of approximately 10 inches in two to three hours.

Tests were made in ground beds of loam soil with moisture contents ranging from 11 to 15 per cent. To facilitate accurate measurement and to gain a more complete picture of the rise in temperature of the soil at different depths and locations beneath the pan, thermocouples of copper constantan were buried at 3-, 6-, 9-, and 12-inch depths. One set was placed 3 inches in from one corner, another near the middle of one side, and a third under the center of the pan. The soil was loosened with a spading fork before the pan was placed over it. A graphic presentation of the temperatures obtained at the different levels is shown in figure 17.

It took 20 minutes to start the water boiling. The soil temperature began rising at the 3-inch depth 10 or 20 minutes later. In 60 minutes it began to rise at the 6-inch depth, and in 90 minutes at the 9-inch depth. The current was turned off in two hours, at which time the temperature was rising at the 12-inch depth. At the lower levels the temperature continued to rise for some time at a rate similar to the rate of fall in the



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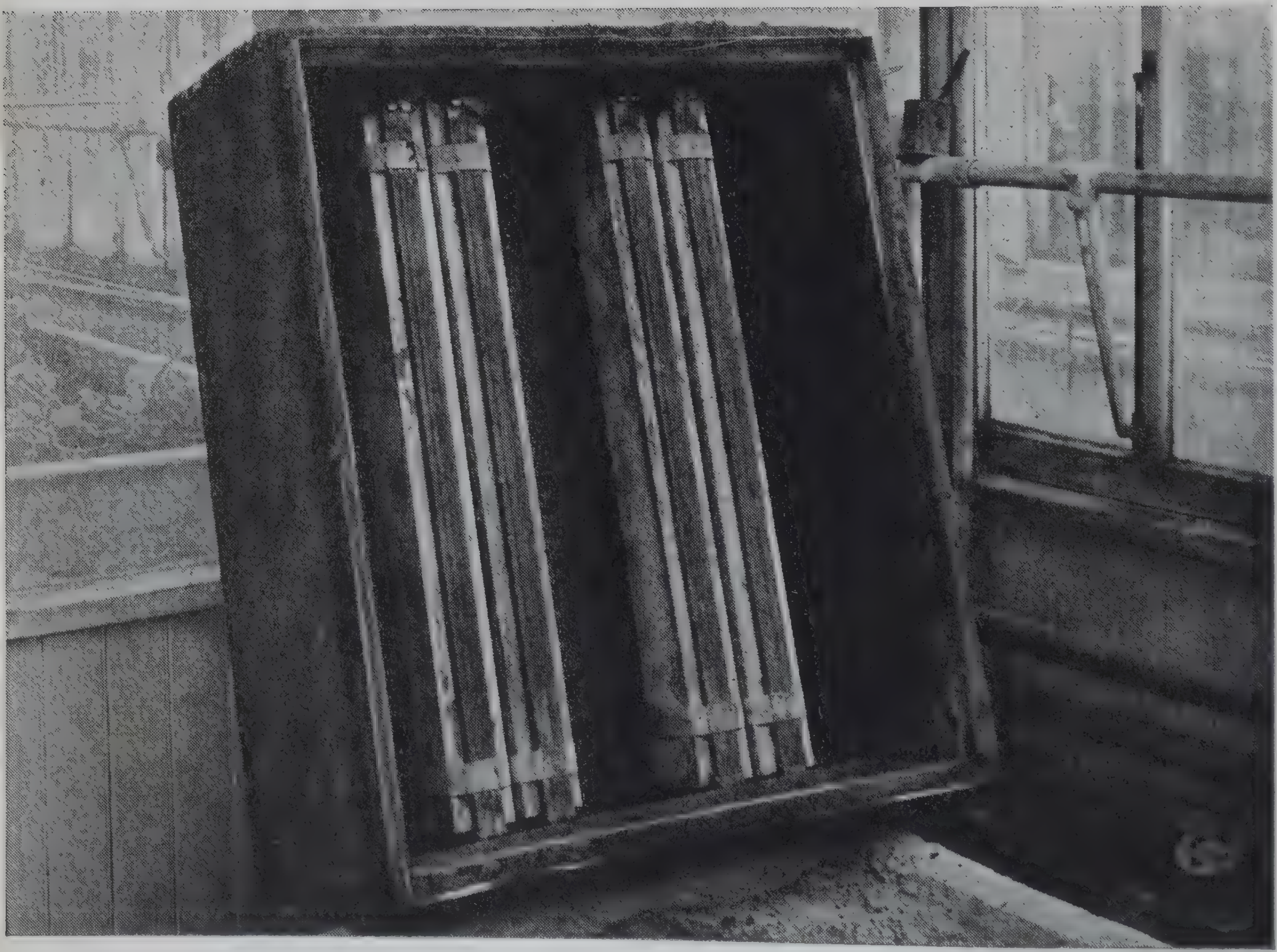
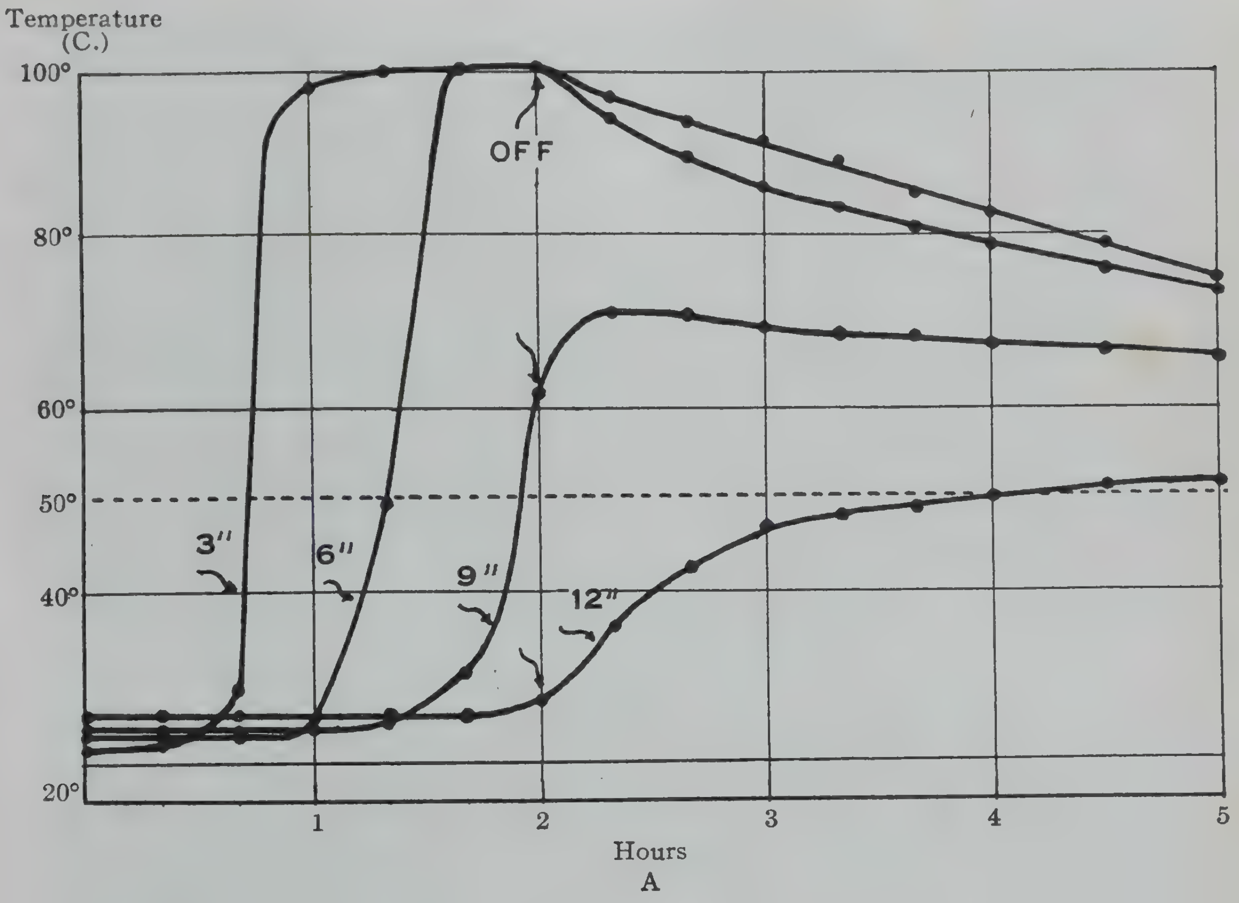


B

FIGURE 16. THE CORNELL ELECTRIC INVERTED STEAM PAN

A, In use on a raised ground bed
B, Tipped on end, showing the arrangement of the four 1500-watt strap heaters beneath the water reservoirs. (See figure 19)

upper layers. Maximum temperatures at the lower depths in the corner were 20 degrees centigrade lower than those under the center of the pan. The water continued to boil for about 15 minutes after the current was turned off, and, as the pan was not moved, there was undoubtedly a con-



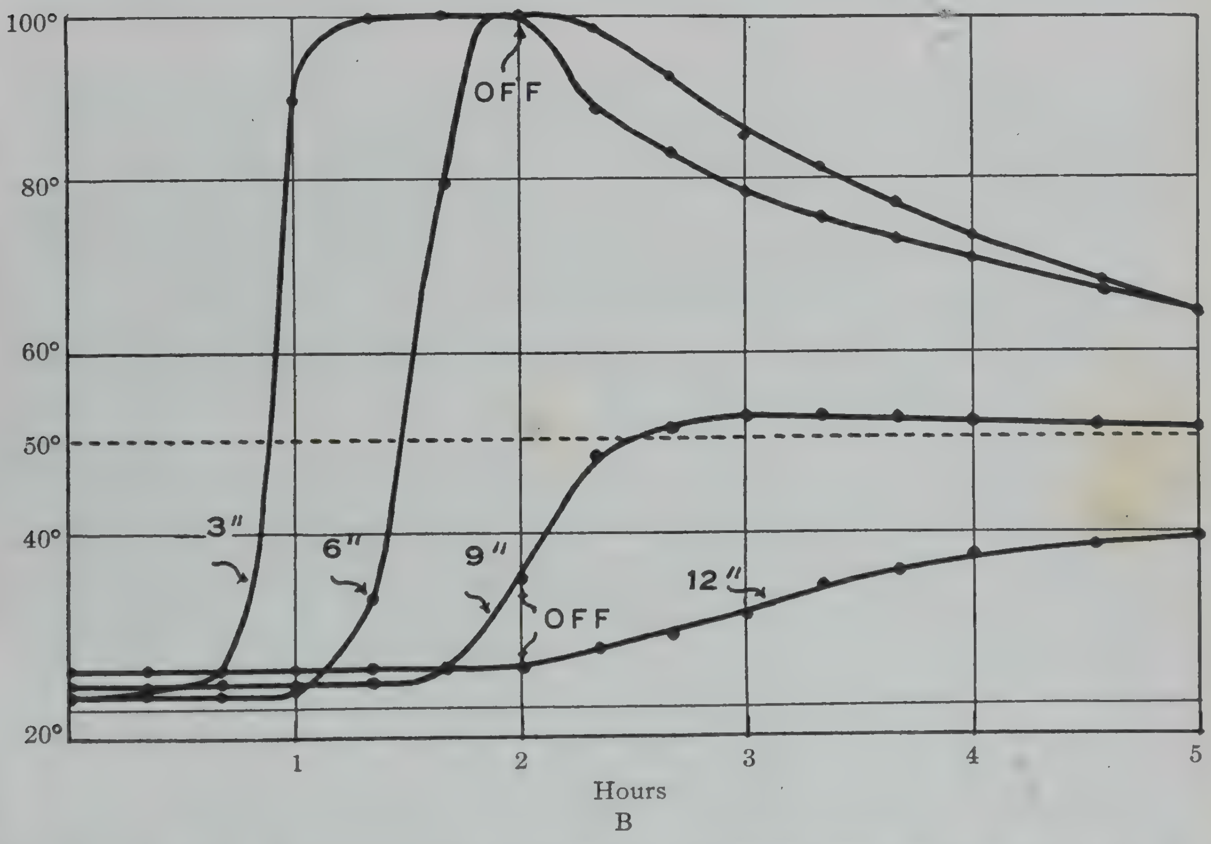


Figure 17. SOIL TEMPERATURES ATTAINED IN A GROUND BED OF LOAM AT 3-, 6-, 9-, AND 12-INCH DEPTHS BENEATH THE CORNELL ELECTRIC INVERTED STEAM PAN DURING A TYPICAL TEST RUN

A, Temperatures at points under the center of the pan
B, Temperatures at points 3 inches in from one corner
The current was on during the first two hours

siderable amount of stored heat given off from the heaters during the next three hours. In practice the best results were obtained by laying a piece of 1-inch composition insulating board on the freshly steamed soil to conserve the heat, and by continuous use of the outfit, which called for shifting it to a new position every two hours, never permitting the heaters to cool off.

The current consumed in treating 7½ square feet of soil was metered at 11 kilowatt-hours, or 1.47 kilowatt-hours per square foot. Assuming pasteurization to a 10-inch depth means 1.76 kilowatt-hours per cubic foot of soil, which is similar in efficiency to that with other methods already described.

A test run on loam made with three of the four 1500-watt heaters produced the results shown in figure 18. It is evident from this figure that pasteurizing temperatures could not be expected much below the 6-inch level without increasing the time of operation beyond two hours. This could be done, however, as there was always some water left in the reservoirs at the end of the two-hour heating period.

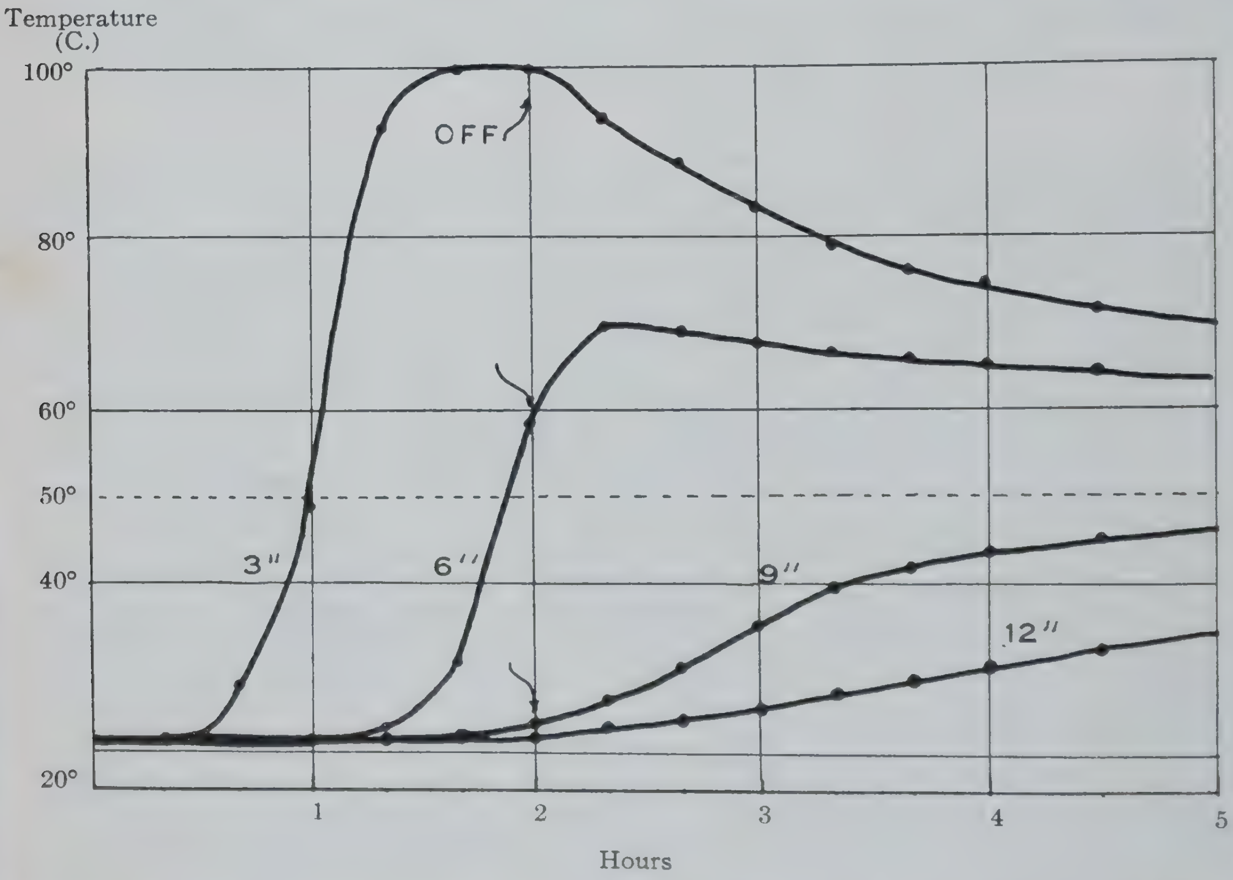


FIGURE 18. SOIL TEMPERATURES ATTAINED IN LOAM AT 3-, 6-, 9-, AND 12-INCH DEPTHS BENEATH THE CORNELL ELECTRIC INVERTED STEAM PAN WHEN OPERATING ON THREE OF THE FOUR 1500-WATT HEATERS

(To be compared with figure 17, A)

From these tests it was deduced that the four heaters used would be adequate for a pan of 25 or 30 per cent larger area, or approximately 10 square feet, without increasing the required heating period too much. Accordingly such a pan was built of asbestos board and angle iron by the Joseph Harris Seed Company, and was put into operation on that company's slat-house soil out-of-doors in the spring of 1939 (figure 19).

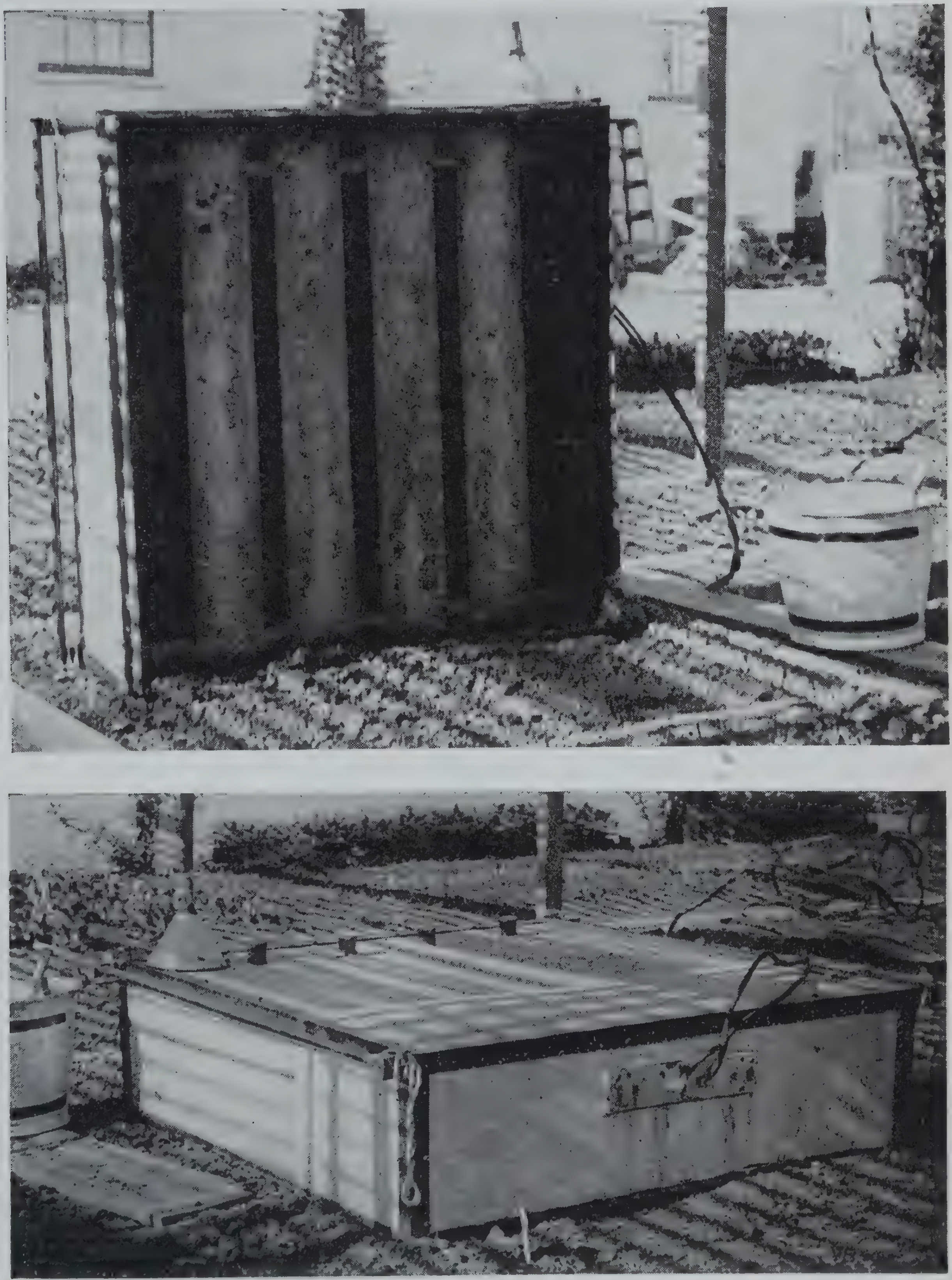


FIGURE 19. MODEL OF AN ELECTRIC SOIL PASTEURIZER BUILT OF ASBESTOS BOARD AND ANGLE IRON, COVERING 10 SQUARE FEET OF SOIL

This pasteurizer, used outdoors on slat-house soil of the Joseph Harris Seed Company at Coldwater, New York, is heated by four 1500-watt strap heaters. The upper photograph shows the strips of asbestos board which shield the soil from direct radiation

Periods of operation of 45 minutes were sufficient to reduce the number of weeds (chiefly grass) from nearly 500 per square yard to less than 12, which amply paid for the current consumed. Such treatment also seemed to eliminate all damping-off of delphinium, which is very subject to this trouble. Temperatures up to 65° C. were attained 4 or 5 inches below the surface of the soil.

Limitations, advantages, and suggested improvements

At this point it is easy to see that limitations as to the area which can be steamed with electrical energy are imposed by the limited size of the service lines at most men's disposal. To provide for an area of 150 square feet at a time, which is not large in commercial operations employing steam, would require a battery of sixty 1500-watt heaters, which would demand 90 kilowatts, or more than 400 amperes. This load would require a transformer, conduits, and heavy cable, and would increase considerably the difficulties and hazards in manipulating the apparatus. All electrical methods for the average grower are definitely limited to comparatively small operations where large areas do not have to be treated in a few days' time.

One advantage possessed by the electric inverted pan is the fact that the surface of the soil is left in a comparatively dry condition, owing to the radiant heat given off by the strap heaters just above the soil. For some situations this is an improvement over methods which may leave the soil in a puddled condition. However, there was evidence that this too can be overdone to the point of overheating the surface soil. In order to avoid such overheating, strips of Transite,[10] 4 inches wide and ½ inch thick, were mounted immediately beneath the strap heaters. These reduced the direct radiation from the heaters to the surface of the soil.

Longer life could be built into this pan by giving the inside a heavy water-proof coating to prevent the insulating board from absorbing moisture. The pan could be made more rigid by lining or covering it with sheet metal, or by using angle iron on the edges; but care must be taken to guard against short circuits and current leakage in the highly saturated atmosphere within the device. It would be desirable to have some means of determining how much water remained in the reservoirs at any time. Also, a spirit level could well be made a part of the regular equipment.

The Hutchings continuous electric soil pasteurizer

In the spring of 1939 the author was invited to collaborate in designing and testing an ingenious soil pasteurizer made by Donald Hutchings, of the Joseph Harris Seed Company at Coldwater, New York. The device, illustrated in figure 20, is unique in its resemblance to modern electric baking ovens of the continuous type or to some types of flash pasteurizing equipment. The soil, which is dumped into a hopper at one end, begins coming out at the other end in 5 minutes, at a temperature of 65° to 80° C. Its passage through the pasteurizer is regulated so that the organic matter is not overheated and yet a sufficient temperature is attained to kill pathogenic organisms and nearly all weed seeds. A few seeds of legumes survive. The soil is propelled through the pasteurizer by a specially constructed continuous chain operated by a ⅓-hp electric motor. The speed is controlled by a motor on a reducing gear and a set of pulleys of varying sizes. The chain picks up the soil under the hopper and drags it horizontally in small piles, ½ inch deep, across a stainless-steel table 6 inches

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[10] A Johns-Manville product containing asbestos.

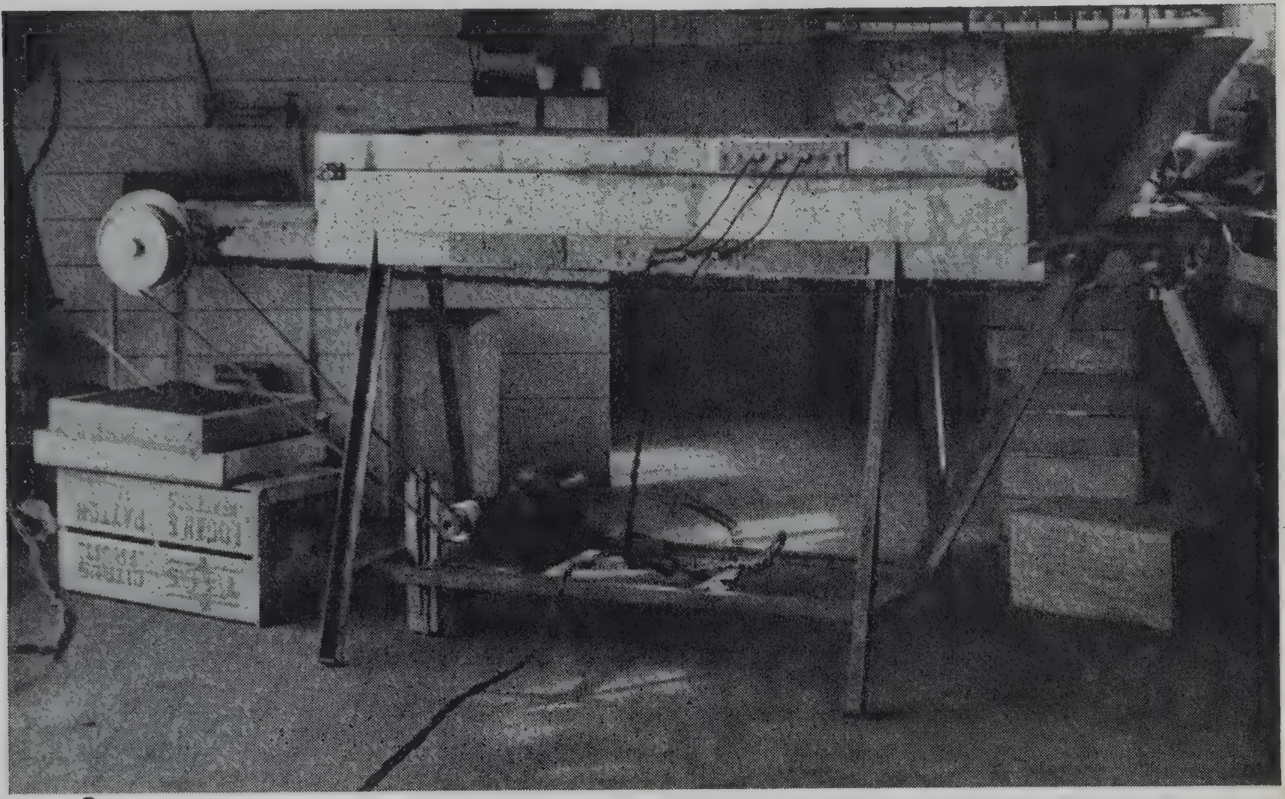

Figure 20. THE HUTCHINGS CONTINUOUS ELECTRIC SOIL PASTEURIZER, IN USE AT COLDWATER, NEW YORK

This device draws 10 kilowatts and pasteurizes 6.6 cubic feet of soil per hour

wide by 64 inches long. This table is heated from below by a number of strap heaters with a total effective wattage of 5.340 kilowatt-hours. Additional heat is directed downward on the moving soil by a set of six 1000-watt "sunbowl" heaters mounted just above and having a total effective wattage, on 205 volts, of 4.625 kilowatt-hours. All of this mechanism is fully enclosed and insulated against heat losses to the outside air. Approximately 15 minutes is required to create a sufficient temperature within the box. After that, 18 to 20 flats of soil can be put through each hour, or 6.6 cubic feet, which means that 1 cubic foot is treated with approximately 1.5 kilowatt-hours after pre-heating of the device, or about 0.5 kilowatt-hour per flat.

As the soil drops into empty flats which are then left overnight in piles, it retains much of its heat for some time and probably exercises some pasteurizing effect on the flats themselves. The temperature of the soil after standing for an hour in the center of one of these piles of flats, was still 50° C.

In testing the device, flats of previously prepared loam known to be infested with damping-off organisms and adjusted to various moisture contents were put through the pasteurizer. Each flat was then planted with 150 seeds of cucumber, which is very subject to damping-off. Nearly perfect stands were obtained in all of the treated flats, while the stands in the two untreated flats averaged only 74 per cent. The temperatures, moisture contents, and stands of cucumbers and weeds in this test are summarized in table 5.

The driest sample of soil (8 per cent) was too dry, since it came out of the pasteurizer in a slightly dusty condition. The wettest sample (56 per

TABLE 5. RESULTS OF TESTS OF THE HUTCHINGS CONTINUOUS ELECTRIC SOIL PASTEURIZER, MARCH 1939

	Original soil moisture (per cent)	Original soil temperature (C.)	Final highest soil temperature attained (C.)	Stand of cucumbers (per cent)	Number of weeds per flat
Untreated soil:					
Check 1	10	20°	20°	68	20
Check 2	10	20°	20°	80	25
Treated soil:					
Dry 1	8	3°	68°	98	0
Medium dry 2	16	5°	69°	99	0
Medium moist 3	23	7°	76°	100	0
Wet 4	56	4°	75°	100	0

cent), on the other hand, was too moist, because it tended to pack between the cross members of the chain which propelled it. Excess moisture has been found to cause some soils to ball up in an unsatisfactory manner. Although vapor can be seen passing off as the soil drops from the end of the pasteurizer, there is very little evident change in total moisture content during the entire process because of the short time that has elapsed, the comparatively low maximum temperatures reached, and the covering of each flat by its successor.

Whether this rapid pasteurizing of soil will prove adequate to control all soil-inhabiting pathogens and all weed seeds remains to be seen. But to obtain higher soil temperatures or longer heating periods simply requires different-sized pulleys to slow up the passage of the soil a little. One important factor in the success of this device may be the prompt piling of treated flats so that the heated soil may cool slowly, like a fireless cooker, for several hours. This practice will probably control even the most difficult organisms. A good many hundreds of flats of soil have been put through this machine during the past two seasons, with very satisfactory results.

Needless to say, the soil must be free from all stones, sticks, or other solid objects which could clog the mechanism, permit overheating, and cause unnecessary delays. It is necessary to employ heaters that will stand the high temperatures resulting from their confinement, and to use plenty of good thermal insulation to avoid heat losses.

DISCUSSION

In the testing of several different types of electric soil-pasteurizing devices, the author has had in mind the ever-increasing demand for a dependable, economical, and safe means of ridding the soil of its parasitic microorganisms, weed seeds, and insect pests. The use of electricity in heating soils is advantageous for several reasons. One is that heat is universally effective against practically all the pests commonly found in soil. Another is that electricity is becoming more available at rates that are increasingly inviting. Still another is that in many places where the climate is too mild to warrant steam-heating equipment, electricity is a logical substitute as a source of power for heat.

Cabinet types of electric pasteurizers have been in use for eight years and have proved successful for potting soil, flats, and benches where some extra handling of the soil was not particularly objectionable. But the problem of economically treating soil in ground beds, coldframes, hotbeds, and cutting beds without having to cart the soil to and from the pasteurizer, has never been satisfactorily solved for the man who has no available source of steam. While the tests reported herein show that it is possible to use buried pipe-type electric heaters for this purpose, the labor and expense involved will probably hinder the adoption of this method.

The development of the Nixon electric dairy-utensil sterilizer paved the way for successful application of the same principle to a portable inverted steam pan operated by electricity. It is felt that in developing this device some progress has been made toward solving the question of a method of pasteurizing soil in place without having to move it, where only electricity as a source of heat is available. At present the process is not rapid enough to recommend the adoption of the method where large areas must be treated quickly. For example, it took 14 hours to treat 125 square feet of cutting bench with a pan covering 7½ square feet at a time and drawing nearly 6 kilowatts. Although the cost of $1.25 for current (2 cents per kilowatt-hour, or 1 cent per square foot) was low enough, the time consumed was too long to justify recommending the method for large areas. Increasing the size of the pan to hasten the work puts heavy demands on the service line and increases the hazard, so that at present the device is adapted to comparatively small operations. However, the ease with which it pasteurizes loam to a depth of 8 or 10 inches with the expenditure of only 1.5 kilowatt-hours per square foot, and a cost for construction as low as that of most other pasteurizing equipment of like capacity,[11] recommend this pasteurizer for trial not only in greenhouses but also on coldframes, hotbeds, and cutting benches, on outdoor slat-house soil, or wherever an ordinary inverted steam pan could be used. The size employed in these experiments drew slightly less than 30 amperes on a 230-volt alternating-current supply line.

For the firm or the individual employing a considerable amount of soil for seedling flats or pots every day, a pasteurizer of a continuous semi-flash type, which will heat enough soil in a few hours for the next day's needs without changing the moisture content appreciably, may prove useful in regions where electric rates are comparatively low. The Hutchings continuous electric soil pasteurizer built on these lines has been in successful operation for two seasons with an expenditure approximating 1.5 kilowatt-hours per cubic foot, or less than 1 cent per flat. Reduction in the cost of weeding is said to offset this expense. An advantage pertaining to both the Nixon and the Hutchings device, particularly the Hutchings, is their ability to kill plant pathogens without subjecting the soil to a long sterilizing period at unnecessarily high temperatures. It is believed that low-temperature pasteurization and speed are both of importance, especially where soils that are rich in nutrients and high in lime are being heated. Such soils are very likely to be temporarily injured by overheating, which results in poor germination and poor seedling growth.

Injury from overheating rich soils seems to be due in general to the increase in soluble salts, particularly to an increase in nitrates and ammonium salts brought about by reduction of the organic nitrogen as shown by Lyon and Bizzell (1910), Johnson (1919), and other investigators. Not all soils are equally affected, but composts are perhaps the most readily injured. Some plants, such as lettuce, sweet peas, snapdragons, spinach, and tomatoes, are more sentitive to these adverse changes than are others. Plants of the grass family, the cucurbits, and other deep-rooted plants are more resistant. The changes are temporary and are somewhat proportional to the richness (organic content) of the soil as well as to the length of the heating period and the temperature used. After a few weeks of retarded growth, plants in overheated soils usually experience a period of stimulated growth.

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[11] The chief item of expense was $20 for the four heaters themselves, while other items brought the total cost of materials to approximately $28.

Injury from overheating soil can often be remedied by prompt leaching with hot or cold water in amounts up to 3 or 4 gallons to a square foot of soil. Such soil is also benefited by simply postponing its use for 10 to 20 days to permit the resumption of bacterial and fungal activity, or by liberal applications of superphosphate or of organic matter such as chopped straw. Herzog (1939) has recently stated that fungal activity during a 42-day period following soil sterilization is much greater in acid soils (pH 4.7) than in alkaline soils (pH 7.6).

Lawrence (1938) recommends the treatment of loam soil for composts, and of manure or leaf mold, separately, and mixing them afterward. This is especially advised if the compost is not to be used for several months. Loams high in lime are more likely to suffer injury than are acid soils, and lime should not be added to a soil before pasteurizing. If these simple rules are adhered to, the most satisfactory results should be obtained in the growing of seedlings and other plants in soils from which all pathogenic organisms have been eliminated by pasteurization.

SUMMARY

From a consideration of the thermal death-points of more than 120 plant-pathogenic microorganisms, coupled with practical soil tests, the conclusion is reached that a final soil temperature of 65° C. (150° F.) is sufficiently high to ensure pasteurization against all important plant pathogens as well as most weed seeds.

Electrical means of pasteurizing soils divide themselves into two general methods, the direct-heating and the indirect-heating. Since the advantages with respect to safety lie principally with the indirect-heating method, a number of attempts were made to extend the usefulness of this method, which involved the testing of different kinds of equipment.

Experiments with ordinary soil-heating cable showed this to be unable to withstand the temperature required of it in soil-pasteurization work.

An induction type of electric pipe grid was employed more or less successfully for a short time by one of the electric power companies; this is described on page 13.

Soil in greenhouse benches and ground beds was brought up to pasteurizing temperatures with a series of buried portable pipe-type heaters, of ¾-inch galvanized pipe, having a rating of approximately 100 watts per linear foot and spaced to give 220 to 400 watts per cubic foot of soil.

Successful use was made of the new Nixon electric dairy-utensil steamer for pasteurization of soil in flats, or trays. The characteristics of this device were studied in a series of more than 250 test runs, in which it was shown that pasteurizing temperatures could be obtained in two to three hours at an expenditure of approximately 1.37 kilowatt-hours per cubic foot of soil treated. No appreciable pressure of the steam generated is necessary for adequate soil treatment.

A portable, electrically operated, inverted steam pan was tested. With this device, pasteurizing temperatures in bench and ground-bed soil were obtained to a depth of 7 to 10 inches in two hours with the expenditure of approximately 1.5 kilowatt-hours per square foot of soil. The device appears to have promise as a means of treating coldframe, hotbed, cutting-bench, seedbed, and slat-house soil while in place.

A continuous or semi-flash type of electric soil pasteurizer was tested, in which the soil is placed in a hopper at one end and discharged 5 minutes later from the other end, having attained a temperature of 65° to 80° C. on its way through at an expenditure of 1.5 kilowatt-hours per cubic foot of soil treated.

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Handling and Shipping Lettuce in New York

Hans Platenius

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HANDLING AND SHIPPING LETTUCE IN NEW YORK[1]

HANS PLATENIUS

Large-scale production of lettuce in New York has become a specialized industry confined almost entirely to the muck areas of Oswego, Genesee, Orleans, and Orange Counties. On upland soil, lettuce is grown on a relatively small scale by market gardeners for local trade; only the market growers of Long Island ship appreciable quantities of lettuce to the New York City market.

Until 1938, the principal types of lettuce grown on the muck areas of New York were Boston, iceberg, and romaine; the latter two comprised less than one-third of the total acreage. The production of Boston lettuce had been declining from year to year because of the competition with iceberg lettuce from California. This situation changed abruptly in 1938 when strains of iceberg lettuce became available which, except in the hottest part of the summer, produce a solid head under climatic conditions prevailing in New York. This led to a rapid expansion of the acreage in iceberg lettuce, with a continued decline in the production of the Boston type.

Together with the increase in the shipments of iceberg lettuce from upstate New York, new methods of packing and handling were introduced. Some growers felt that a good type of iceberg lettuce could compete successfully with lettuce grown in California only if packed with ice in the package, as is generally done in the Western States. This practice would enable them not only to offer a package which in appearance compares favorably with that of competing States, but would also insure the arrival of the lettuce on the market in the best possible condition. The fact that package-icing and effective grading cannot be carried out in the field led to the establishment of several centralized packing plants in Oswego and Wayne Counties.

Another innovation introduced about the same time was the practice of precooling, making use of available cold-storage facilities. This trend developed in connection with the rapid expansion in the use of motor trucks for long-distance shipments of produce. Receivers frequently complained that lettuce arriving by truck was partly wilted and in poor condition, making it difficult to dispose of the produce even at a sacrifice.

At present, neither package-icing of iceberg lettuce nor precooling of truck shipments is being practiced generally in New York. In fact, during the 1939 shipping season, the major part of the lettuce crop still moved in field packs by truck, protected against excessive wilting only by a layer of crushed ice spread over the top of the load.

SCOPE OF THE STUDY

The studies presented in this bulletin were carried out to determine whether it is advisable to make changes in the common methods of handling and packing; and, in particular, to determine to what extent methods

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used in the Western States could be modified to adapt them to New York conditions.

In discussing these problems with growers and shippers, it was evident that they had little factual information on which to base an intelligent decision as to which particular practice should be followed. Some growers argued that package-icing and precooling may be necessary for transcontinental shipments of produce, but that these practices involved an expense unnecessary for New York producers because of their nearness to the market. They pointed to the fact that frequently field packs sold on the market for the same price as did lettuce that had been precooled or iced. In spite of this contention, the number of growers who adopt modern packing methods is increasing steadily. There was much discussion of the relative merits of shipping by rail or truck, but few data were available which could serve as a reliable guide in evaluating the different means of transportation.

In these studies, facts and data were sought on which to base definite recommendations, taking into account the particular type of lettuce grown, available facilities, distance from the market, and the cost of different packing and precooling methods.

First, a survey was made of handling methods, the type of containers used, and available means of transportation. Next, data were obtained to ascertain the length of time and the temperature to which lettuce is exposed when handled in different ways, two factors which play a dominant role in determining the condition of the product on arrival at the market. After studying carefully the effect of temperature on the rate of deterioration of lettuce under controlled conditions, it was possible to predict with sufficient accuracy which particular method is best suited for maintaining a high quality during transit. Conclusions drawn from these studies were checked with records of temperature and condition taken at the shipping point and on the market. It was found that the conclusions arrived at by these different methods of approach agreed surprisingly well.

FACTORS DETERMINING THE PRICE OF LETTUCE

Aside from the influence of particular market conditions, as affected by supply and demand, the price of a given lot of lettuce depends on both its quality and condition. Although this bulletin is concerned primarily with handling and shipping methods which affect the condition of the product, attention should be called to the fact that the quality of the heads, in particular their solidity, is by far the most important factor in determining their price. This is illustrated by the wide variation in price that is paid for lettuce of similar condition, but differing in the relative compactness of the heads. It was found, for instance, that 20 lots of iceberg lettuce received on the New York City market from Oswego County on a certain day sold at prices varying from 80 cents to $2.50 per two dozen heads. Since all of these lots had been packed and shipped in the same way, they showed no perceptible difference in condition, and the price difference must be attributed solely to variations in quality. Similarly, Knott (1936) showed that the price of Boston lettuce is affected primarily by the stage of maturity and solidity of the heads.

Therefore, a correlation between the actual condition of the lettuce, as affected by different handling methods, and the price received could yield reliable data only if it were possible to select for such a study lots containing heads of exactly the same solidity and size. This is also one reason why some growers have been led to erroneous conclusions when they observed that field-packed lettuce occasionally sells on a par with package-iced or precooled lettuce; they did not realize that the lots involved may have differed appreciably in maturity and solidity of the heads.

However, the condition of the lettuce at the time of arrival also has a pronounced effect on the price. Frequently lettuce is received on the market with the outer leaves badly wilted. In extreme cases, the heads have a musty odor or show signs of decay. Such lots can be sold only at a considerable discount. If receipts are particularly heavy on a certain day, some lots which are in poor condition are not purchased, with the result that the grower receives no return for his lettuce, but owes the receiver for the cost of freight and cartage.

Another factor which has a considerable effect on price is the extent to which heads have been trimmed. Even a superficial observer on the market soon will notice that, in general, lettuce from California is trimmed much more closely than that from New York. This is especially true for lettuce packed in the field. On the market, buyers invariably take a few heads out of the display crate for closer inspection and unless the lettuce has been trimmed very closely, the top layer soon becomes covered with loose and broken leaves, which makes the heads appear less solid than they actually are.

Growers need not fear that close trimming makes the heads too small. In fact, it was observed that head size had very little influence on the unit price paid. Close trimming always gives the lettuce a more compact appearance, simply because the outer part of a head is less solid than the interior.

Little need be said about tipburn and yellows. Most growers realize that crates of lettuce showing only traces of these types of defects are rejected by the buyer or have to be sold at a considerable discount.

The foregoing statements are based on frequent observations on the wholesale markets and on comments made by buyers and commission men. No attempt has been made to carry out a price analysis which would show to what extent the different factors mentioned govern the price paid for the various lots of lettuce on the market. While such a study might be of great value to the grower and shipper, it would be difficult to carry out, mainly because of the many factors involved and also because a head of lettuce does not lend itself readily to precise physical measurements.

SURVEY OF PRESENT METHODS USED IN HANDLING AND SHIPPING LETTUCE

Containers. Prior to 1938, practically all lettuce shipped from the muck areas of New York was packed in the standard New York lettuce crate, which has inside dimensions of 7½×16×19 inches (figure 1). The crate is designed to hold 24 heads of the Boston type, but does not have sufficient room to permit the addition of package ice. It is still being used almost exclusively for Boston and romaine lettuce and that portion of iceberg lettuce which is packed directly in the field. Because of the relatively small size of the crate, the temperature of the lettuce rapidly follows changes in the outside air temperature. That is, if if placed in a cold-storage room the

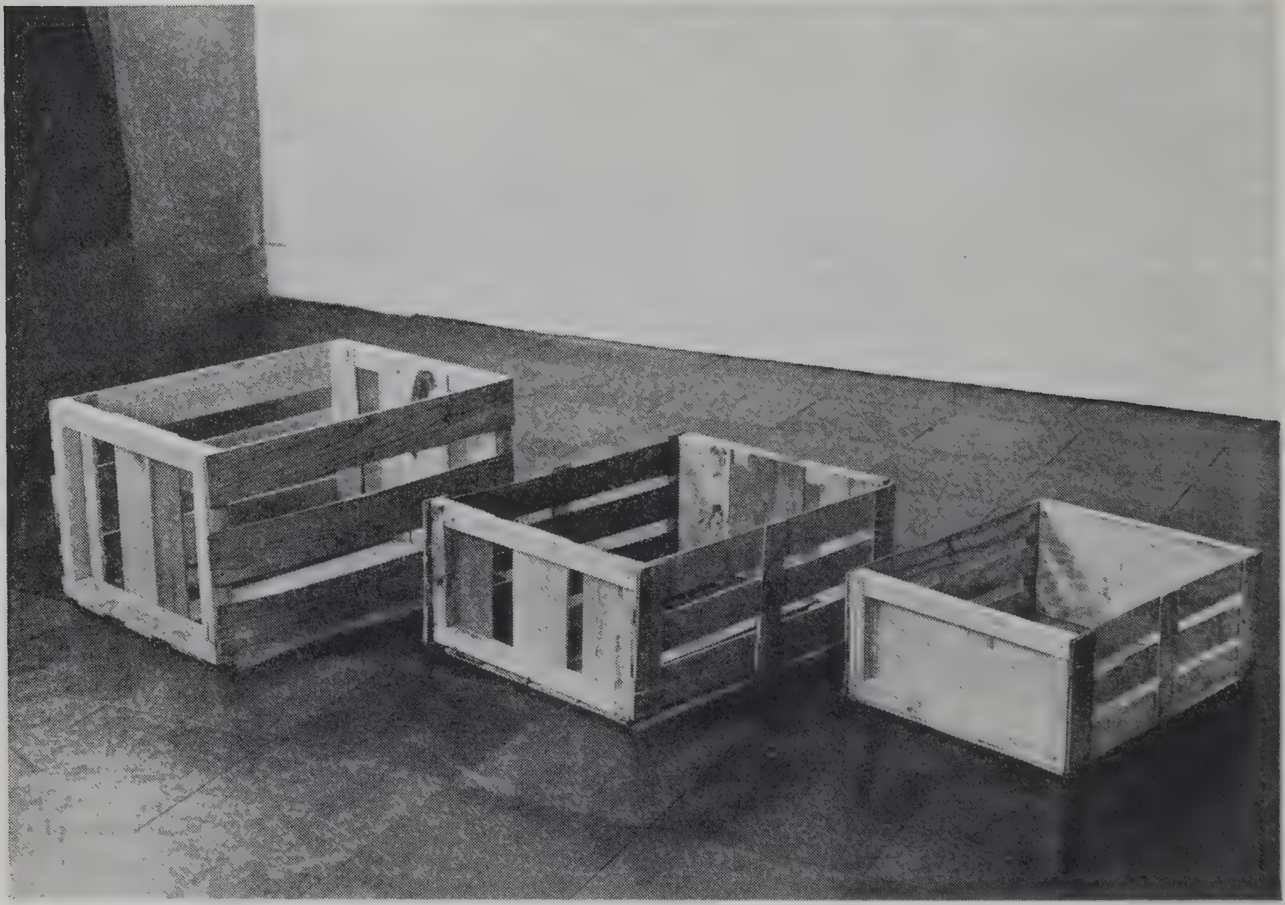

FIGURE 1. THREE TYPES OF CRATES COMMONLY USED IN NEW YORK FOR THE SHIPMENT OF LETTUCE

Left to right: Los Angeles, or full-sized, crate, which holds 4 to 6 dozen heads of iceberg lettuce; half crate, which holds 2 to 3 dozen heads of iceberg lettuce; Boston crate, used for field packs of iceberg, Boston, and romaine lettuce

rate of cooling is fairly rapid; on the other hand, after removal from cold storage the temperature of the heads quickly assumes the temperature of the air or rises above it.

When growers began to use package ice for iceberg lettuce, they adopted a different type of package, the Los Angeles, or western, lettuce crate with inside dimensions of 13×18×21⅞ inches, designed to hold 4 to 6 dozen heads (figure 1). It is usually packed in three layers with 40 to 45 pounds of crushed or snow ice between layers. Two sheets of crate liners are used for additional protection against mechanical injury and rapid wilting. After closing, the crate shows a slight bulge, just enough for tight packing in a refrigerator car or truck, but not so much as to cause bursting of the crates or injury to the product. In 1939, the price of the empty Los Angeles crate was 22 or 27 cents, depending on whether the slats and panels were made of veneer or of sawed lumber.

After the season of 1938, some growers began to use a third kind of container, the half crate (figure 1). This crate is about as long and wide as the Los Angeles crate, but differs from it in having a depth of 9 instead of 13 inches. It sells for about 15 cents, made up. Depending on the size of heads to be packed, it holds from two to three dozen heads of iceberg lettuce. In one packing plant 15, in others 40, pounds of package ice were added.

Those advocating the use of the half crate advanced two plausible arguments. They pointed out that all of New York iceberg lettuce is shipped during midsummer and that in many cases two or three days would be required to sell, in the retail store, the four or six dozen heads contained in the Los Angeles crate. Under such conditions, losses from deterioration would necessarily be heavy unless the crates are divided by the wholesaler or jobber, a procedure which adds to the cost of selling and also deprives the lettuce of the full benefit derived from the package ice. The second argument put forward in favor of a smaller crate was the belief that it might be desirable to have a distinct type of crate which, at a glance, distinguishes the lettuce as having been grown in New York instead of in California. It is difficult to see, however, how on the basis of the latter arguments a smaller type of crate would aid in promoting the sale of New York lettuce, particularly in view of the fact that, in general, California lettuce has a better appearance than has that grown locally.

A brief survey carried out in New York City during the spring of 1939 showed that of 20 commission men and managers of retail stores who were interviewed, 15 showed a preference for the half crate, mainly because of the fact that the contents of a full crate can seldom be sold in a retail store during a single day. Nevertheless, when the actual shipping season got under way, it became evident that the buyers on the market gave preference to the full-sized crate; at least they were unwilling to pay a premium for heads packed in the half crate. Likewise, the comments of buyers at the shipping point indicated a preference for the larger lettuce crate, and several commission men who earlier had favored the half crate admitted that they had changed their minds.

One reason why preference was given to the Los Angeles crate was undoubtedly the fact that the unit cost of packing is somewhat lower for the large crate than it is for the small crate. Assuming that the two crates have a capacity of 5 and of 2½ dozen heads respectively, the cost of the crate per dozen heads would be 5 cents for the Los Angeles and 6 cents for the half crate. This difference is further increased by the relative number of crate liners and the quantity of package ice required. Also, transportation charges and costs of handling both at the shipping point and on the market are relatively higher for the small than for the large crate. It is estimated that the total difference in cost of packaging and handling the two types of crates varies from 2 to 3 cents per dozen heads. On a highly competitive market this difference is of considerable importance and may affect the ultimate returns to the grower by several hundred dollars in the course of the shipping season.

These facts have been fully realized by the managers of the various packing houses, with the result that those who used the half crate during the summer of 1939 have decided to ship all iceberg lettuce in the large crate during the coming season.

There is probably little difference between the two types of crate in the condition of the lettuce itself. Lettuce packed in the Los Angeles crate tends to heat up less rapidly than does the lettuce in the half crate because relatively less surface is exposed to the outside air. On the other hand, the relative quantity of package ice used in the half crate is considerably larger than that added to the full-sized crate and this is sufficient to offset the effect of the relative surface exposed.

Grading and packing. The entire crop of Boston and romaine and a large share of the iceberg lettuce are packed directly in the field. Centralized packing sheds for repacking of iceberg lettuce are located only in Wayne and Oswego Counties.

The usual method of field-packing consists in going over a field once or twice, cutting each time only those heads that appear to be of marketable size and quality. They are trimmed and packed, without further grading or package-icing, directly in the field. Obviously, the quality of the pack depends largely on what the grower considers to be marketable quality. Only occasionally do growers make an attempt to grade in the field by setting up portable grading tables. In Orange County, one grower added crushed ice to the package, having an ice crusher mounted on a truck following the crew engaged in cutting and packing.

Field-packing naturally involves a minimum of expense and is recommended under present conditions for Boston and romaine lettuce because these varieties are easily bruised during rehandling in a packing plant; also, because the price received by the growers does not warrant the extra expense of careful grading and repacking; lastly, because it is inadvisable to use package ice for these types. The principal disadvantage of this method is the fact that the lettuce packed without ice in the field tends to heat up rapidly and frequently reaches the market in badly wilted and partly deteriorated condition unless the crates are promptly precooled immediately after packing. Cutting and packing the lettuce during the early morning hours when the temperature of the heads is still relatively low and the leaves are still crisp help materially in delaying the wilting process. Another drawback of field-packing is the fact that it does not give an opportunity for effective grading. Consequently, most lettuce, regardless of type handled in this way, shows a wide variation in quality within the crate as well as in different lots. This is one reason why field-packed lettuce as a rule is not sold under a specific brand. Still another disadvantage, which must not be overlooked, is the soiled appearance of the crates and sometimes of the lettuce itself during rainy weather.

As a result of the initiative taken by a few growers and shippers, several centralized packing plants for iceberg lettuce have been established in Oswego and Wayne Counties during recent years. Two principal reasons can be given for this development. It was recognized that, unlike the Boston type, iceberg lettuce can be maintained in good condition for a relatively long time by means of package-icing. Also, it was felt that proper grading and selling under definite brands would help materially in competing more successfully with California lettuce on the market. Naturally, efficient grading, packing, and icing cannot be carried out without the facilities of centralized packing plants. The fact that during the past three years the number of such plants has increased from two to six is an indication that more and more growers have become convinced of the advantage of modern packing methods.

Procedures for grading and packing are similar in the six plants operating in New York at the present time. After the lettuce has been delivered in field crates at the platform, it is dumped on either a stationary or a moving grading table where the heads are trimmed and those of poorquality discarded as culls. After passing through a spray washer the lettuce is sorted according to size and packed with 4, 5, or 6 dozen heads per crate. Single or double sheets of crate liners are used and snow ice is spread over each layer of lettuce. The lids are then held in place with a hydraulic press while they are being nailed to the crates. Labels indicating the brand are pasted on the end panels, and the crates are stenciled to show the quantity of lettuce per crate and the number of the grower.

As pointed out earlier, the appearance and sales value of most lettuce packed in New York could be improved by closer trimming. At any rate, in comparison with shipments from California, iceberg lettuce from New York usually is packed with too many wrapper leaves which are likely to become broken and which are subject to rapid wilting and decay (figures 2 and 3).

Ordinarily, all lettuce of one particular lot is packed under the same brand. Heads which do not meet the quality standards of a particular brand are discarded as culls. If the general quality of the entire lot falls below this standard, the lettuce may be refused for packing or it may be packed under a different brand, which indicates to the buyer that the lettuce has been graded but is of inferior quality. With the exception of the elimination of culls, the grading of iceberg lettuce is done, therefore, for the lot as a whole rather than for individual heads in the package.

Thus far, no attempt has been made to use the grade standards established by the United States Department of Agriculture as a basis for commercial grading. These standards are concerned primarily with certain defects which, with the exception of tipburn, are not common in New York lettuce. Not sufficient importance is given to the relative firmness of the heads, which is by far the most important factor in determining the price

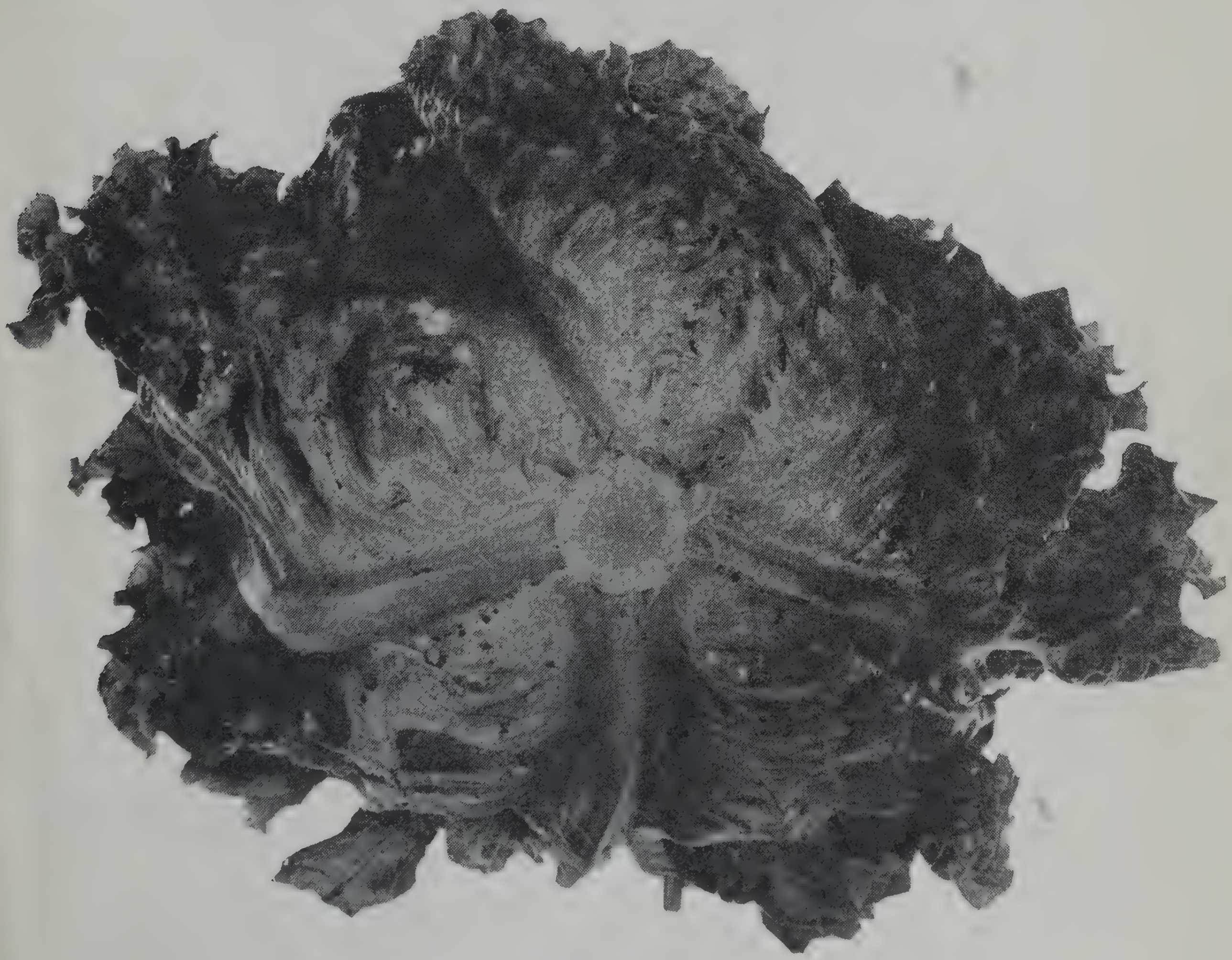

FIGURE 2. A POORLY TRIMMED HEAD OF ICEBERG LETTUCE

Loose outer leaves become easily bruised and are subject to rapid wilting

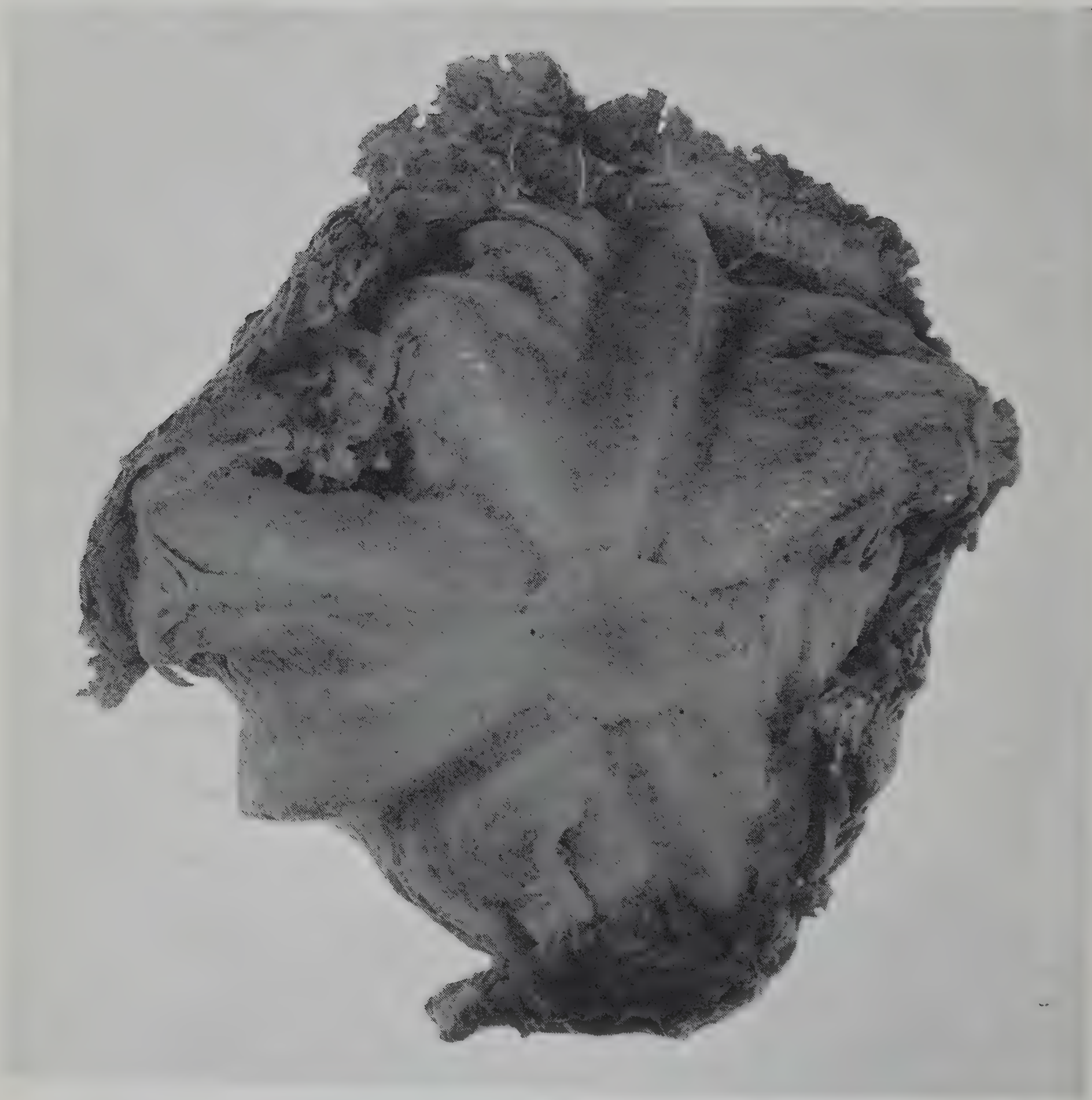

FIGURE 3. A WELL-TRIMMED HEAD OF ICEBERG LETTUCE

Close trimming gives the appearance of a solid head

that may be obtained on the market. It would not be practicable to base the different standards primarily on the firmness of the heads because it is difficult to express the degree of firmness in accurate physical measurements, and it is thus subject to arbitrary judgment.

Wide variations were noticed in the capacity, efficiency, and arrangement of equipment in the different plants. One plant lacked facilities for the prompt removal of culls and trimmings, with the result that a large area of the floor space was covered with refuse a foot deep, greatly hampering the workers in their operations.

Exactly what percentage of iceberg lettuce is handled through packing plants is difficult to determine. According to Efferson (1938) only 21 per cent of the iceberg lettuce grown in Oswego County during 1936 was handled in centralized plants. It is estimated that this percentage has more than doubled in the past three years in this area. The total number of crates repacked and iced has increased at a still greater rate, because the rapid expansion of the acreage in iceberg lettuce must be taken into consideration. Nevertheless, it must be realized that even today more than two-thirds of all the iceberg lettuce grown in New York is still put up in field packs. No packing plants are operating in Orleans, Genesee, and Orange Counties.

Unless a grower owns his own plant, all packing is done on a flat charge per crate. In comparing these charges one must take into account the fact that different types and sizes of crates are used, and also that some plants do not offer selling services. The itemized charge for each service varies but a few cents; a typical example of the total cost of packing a Los Angeles crate is as follows:

Crate and liners	22 cents
Packing, grading, and icing	48 cents
Selling charge	10 cents
Total cost	80 cents

Precooling. Precooling of fruits and vegetables which are not package-iced has become a general practice in most of the producing districts of the West and South. Precooling not only results in lower transit temperatures and a better condition of the produce on arrival, but also makes it possible to make shipments across the continent without re-icing in transit except during exceptionally hot weather. Because of the proximity to the markets, eastern shippers have never felt the need for precooling rail shipments, assuming that top and bunker ice is sufficient to protect the load against heating and deterioration in transit.

The situation is different with respect to truck shipments. For years, receivers have complained about the poor condition of lettuce arriving by truck. In some instances, they threatened to refuse truck shipments unless the load had been precooled at the point of origin. These complaints, together with low returns for shipments that reached the markets in heated and badly wilted condition, forced the shippers and growers to introduce a system of precooling for truck loads. The precooling methods commonly used in the Southern and Western States, such as the Galloway system, were unsuited for this purpose because they had been developed primarily for the precooling of produce loaded in refrigerator cars. For this reason, precooling in New York has to be carried out by the older method of holding produce in cold-storage rooms until the field heat has been removed from the packages. Sufficient cold-storage space is available in all muck sections of New York for this purpose, and this method has the advantage of providing refrigeration for loads of lettuce to be shipped by truck as soon as the lettuce has been packed, thus avoiding exposure to high temperatures in the field or warehouse pending the final assembling of the shipments. In addition, this procedure has the advantage of enabling the grower to withhold the lettuce from a glutted market for several days.

Under this system of handling, lettuce is hauled from the field to a nearby cold-storage house by either the grower or the shipper. The crates are stacked in such a way as to permit as free circulation of air in the room as possible. In most storage houses, forced air circulation is used to obtain a rapid rate of cooling.

Although the practice of precooling lettuce is spreading rapidly, especially in Oswego County, the majority of truck loads are still being shipped without taking this extra precaution. Precooling is confined entirely to field packs; if package ice is added to the crates, this procedure is thought to be unnecessary. The standard charge for precooling service has been established at 5 cents per crate, a rate which, from cost-account data, appears to cover the cost involved and leaves a reasonable, small profit to the operator.

In many instances, the purpose of precooling has been defeated partly or entirely by mismanagement. In some cold-storage houses lettuce was left for periods varying from 3 to 20 hours, too short a time for effective precooling, which, as shown later, requires about 30 hours. In others, precooling was ineffective because the temperature could not be reduced to less than 45° or 50° F., with the result that the temperature of the lettuce at loading time was 60° F. or higher, even though the crates had remained in the room for more than 24 hours.

Transportation. Following the general trend in the transportation of fruits and vegetables, there has been a rapid increase in shipments of lettuce by means of motor truck, with a corresponding decline in rail shipments. The relative merits and disadvantages of these two methods are discussed later in connection with records taken in the field on temperature and condition of the lettuce.

If shipments are made by rail, standard procedures are followed. The cars are usually iced a day before loading by means of bunker ice. Lettuce packed in the field is hauled to the loading station without delay so that the crates are exposed to high temperatures for a minimum length of time. After loading has been completed, 4 to 5 tons of ice are spread over the entire load in the form of chunk or snow ice. This practice of top-icing is now being carried out at all loading stations since the National Perishable Freight Committee has increased the quantity of top ice which may be used in New York without additional charge, from 7500 to 9600 pounds.

Lettuce which has been package-iced in a plant is frequently loaded into cars which contain no bunker ice. It is assumed that the cooling effect of the package ice, together with the top ice, is sufficient to provide satisfactory refrigeration in transit. That this assumption is correct is borne out by the results of precooling studies carried out by Mallison and Pentzer (1938), with lettuce shipments from California, which showed that no material benefit is derived from bunker ice if used in addition to package and top ice. Since 1939, most of the top ice has been added in the form of snow ice. Although Mallison and Pentzer showed that there is little difference in the cooling rate of a load, depending on the form of ice used for top-icing, there are some advantages in using snow ice. It makes it possible to body-ice a load; that is, the snow ice may be blown not only over the top of the load, but also in spaces between crates in different tiers. Also, it can be applied quickly and easily, and there is less danger from breakage or injury to the lettuce than there is from the use of chunk ice.

Truck loads of field-packed lettuce are assembled by the trucker in the field or in a warehouse. In either case, the lettuce remains exposed to the prevailing air temperature from 5 to 12 hours, which results in considerable deterioration. Recognition of the fault in this handling procedure has been partly responsible for the introduction of precooling methods whereby the lettuce is taken to a local cold-storage plant soon after cutting. Loading and top-icing of precooled lettuce is done just before the truck leaves for the market.

All trucks, regardless of the type of lettuce they contain, are top-iced with ½ to 1 ton of either snow ice or chunk ice. The actual quantity of ice used depends on the capacity of the truck and also on the previous handling methods. More top ice is used for field packs than for lettuce which has been precooled or package-iced. Although no accurate temperature records are available for different types of trucks used, there is sufficient evidence to show that the transit temperature of the lettuce is considerably lower in well-insulated trucks than in others. A few trucks have ice bunkers which can be filled for added protection during extremely hot weather. On arrival at the market, there are usually several hundred pounds of top ice left, an indication that an increase in the amount of top ice used would have little effect on the transit temperature of the lettuce. It must be remembered that the cooling effect of ice depends primarily on the melting process. In the conversion of water from the solid ice state to the liquid state, 144 B.t.u. of heat are absorbed per pound and this quantity of heat is extracted from the load. The cooling effect of unmelted ice, owing to the temperature difference of the ice and the lettuce, is very small in comparison.

A decidedly bad feature of truck-shipping is the fact that the loads usually arrive many hours before the market opens. Frequently, the lettuce is unloaded early in the afternoon and remains on the curb, occasionally exposed to the sun, for more than 10 hours before it is removed by the buyer. This disadvantage could be eliminated in part if the arrival of the trucks were scheduled for a later hour, although on some markets, particularly in New York City, this would add to an already intolerable traffic congestion.

TEMPERATURE AND RATE OF DETERIORATION OF LETTUCE

Of the different factors contributing to the deterioration of lettuce, temperature is by far the most important one. The prevailing humidity may have a pronounced effect on the rate of breakdown, particularly on wilting, but ordinarily this factor is of little consequence under commercial conditions because lettuce is seldom exposed to a relative humidity of less than 90 per cent before it reaches the market.

The rate of breakdown of Boston lettuce at different temperatures was studied in a series of experiments during which crates containing two dozen heads were held in constant-temperature rooms at 32°, 50°, 65°, and 80° F., until deterioration had progressed to such an extent that the lettuce would have to be considered unsalable on the market. From these data, it could then be calculated how long lettuce may be exposed to any temperature between 32° and 90° F. before complete deterioration results. All these calculations were based on the temperature of the lettuce itself rather than on the temperature of the storage rooms. Corrections had to be made, therefore, to allow for the fact that the lettuce did not reach a temperature equilibrium for many hours after being placed in a temperature of 32° or of 50° F. Also, account had to be taken of the fact that, once a temperature equilibrium had been established, the temperature of the lettuce always remained several degrees above that of the surrounding air. Details of the experimental procedure and of the method of calculation have been described in an earlier publication (Platenius, 1939). The results of these findings are summarized in figure 4, where the temperature of the lettuce is plotted against the time required to bring about complete deterioration at any given temperature.

In studying this curve, it becomes evident that the rate of deterioration is not at all proportional to the temperature. If true proportionality existed between these two factors, the curve should follow a straight line, and a definite change in temperature should have the same effect on the maximum storage period, regardless of whether this change occurred in the upper or in the lower temperature range. Actually, this temperature effect becomes progressively more pronounced as the lower range is approached. A single example may help to illustrate this relationship.

Assuming, for instance, that the storage temperature of a lot of lettuce is reduced 10 degrees, from 90 to 80° F., the maximum storage period is thereby lengthened 23 hours. A corresponding drop in temperature from 45 to 35° F. lengthens this period by 306 hours; that is, nearly 14 times as much as in the upper temperature range.

These data lead to the following practical conclusions: Whatever handling practices are followed to bring about lower transit temperatures, they are of little value unless they are effective enough to reduce the average temperature to 50°, or at least to 60° F. Also, the return for efficient handling practices becomes progressively higher as lower temperatures are reached; assuming, of course, that the cost of lowering the temperature from 70° to 60° F. is about the same as that for reducing it from 50° to 40° F.

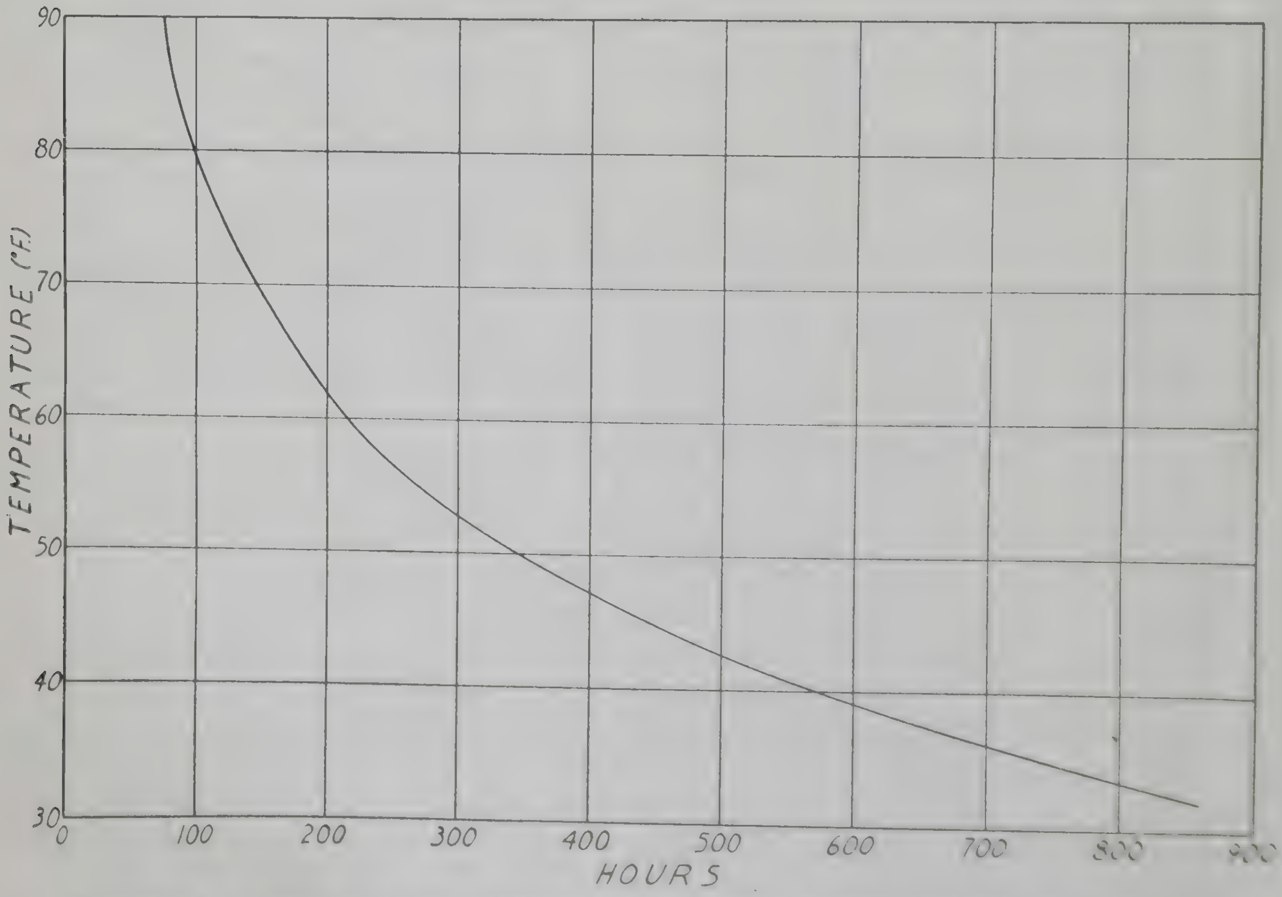

FIGURE 4. RATE OF DETERIORATION OF LETTUCE AT DIFFERENT TEMPERATURES

The temperature is plotted against the time that is required to bring about complete deterioration

EFFECT OF HANDLING AND TRANSPORTATION METHODS ON THE TEMPERATURE AND RATE OF DETERIORATION OF LETTUCE

The data presented in figure 4 made it possible not only to predict how long lettuce will keep in salable condition at any one temperature, but also to calculate the degree of deterioration in terms of percentage of the complete process that the lettuce may have undergone within a given time at a specified temperature. The relative effectiveness of different handling and transportation methods could, therefore, be determined, provided that an accurate record of the temperature was obtained in each case.

With this purpose in mind, more than 200 temperature readings of individual lots of lettuce were taken in Oswego County at loading time and again when the same lots arrived in New York City. The temperature conditions existing at the shipping point and on the market were reproduced in the laboratory as nearly as possible, in order to obtain more detailed records of changes in temperature that may occur in transit. With the exception of lettuce that had been package-iced, differences in the temperature of the lettuce between loading time and arrival were never more than 6 degrees, and slight inaccuracies in the temperature records during transit are therefore of little significance. The march of temperature of package-iced lots was ascertained in several laboratory experiments where readings were taken every 2 or 3 hours during the period of rapid temperature changes.

The temperature of the lettuce was obtained by inserting a short-stem glass thermometer into the center of the head. At least three records were taken for each lot from heads in different parts of the crate. The temperature data for each method of handling and shipping were averaged and expressed in graphic form (figure 5). Although the actual temperature of different lots showed wide variations from day to day as a result of changes in the air temperature, the writer felt justified in averaging the data for each treatment because the same proportion of lettuce packed and shipped in different ways was inspected every day.

A comparison of the effect which different handling and shipping methods have on the time required to bring about ultimate breakdown of the lettuce after it reaches the market are based on these temperature records and also on the known relationship between the rate of breakdown and temperature. This relationship is expressed in figure 4, and from these data it is possible to calculate the fraction of the complete deterioration process that takes place at any one temperature within a certain time interval. To cite an example, it will be found that at 70° F. a period of 145 hours is required for completing the entire process. Consequently, each hour 100/145, or 0.68 per cent, of the deterioration process is completed. In the same way, the percentage breakdown that occurs within an hour at any other temperature can be calculated. By following the temperature curves presented in figure 5, and by determining the sum of the percentages of deterioration based on the average temperature at hourly intervals, the final degree of deterioration expressed on a percentage basis could be calculated for a given treatment.

In these calculations the assumption is made that deterioration proceeds at a uniform rate at any one temperature. The percentage deterioration thus calculated does not necessarily coincide with the degree of visible breakdown as determined by inspection after a definite interval. Assuming,

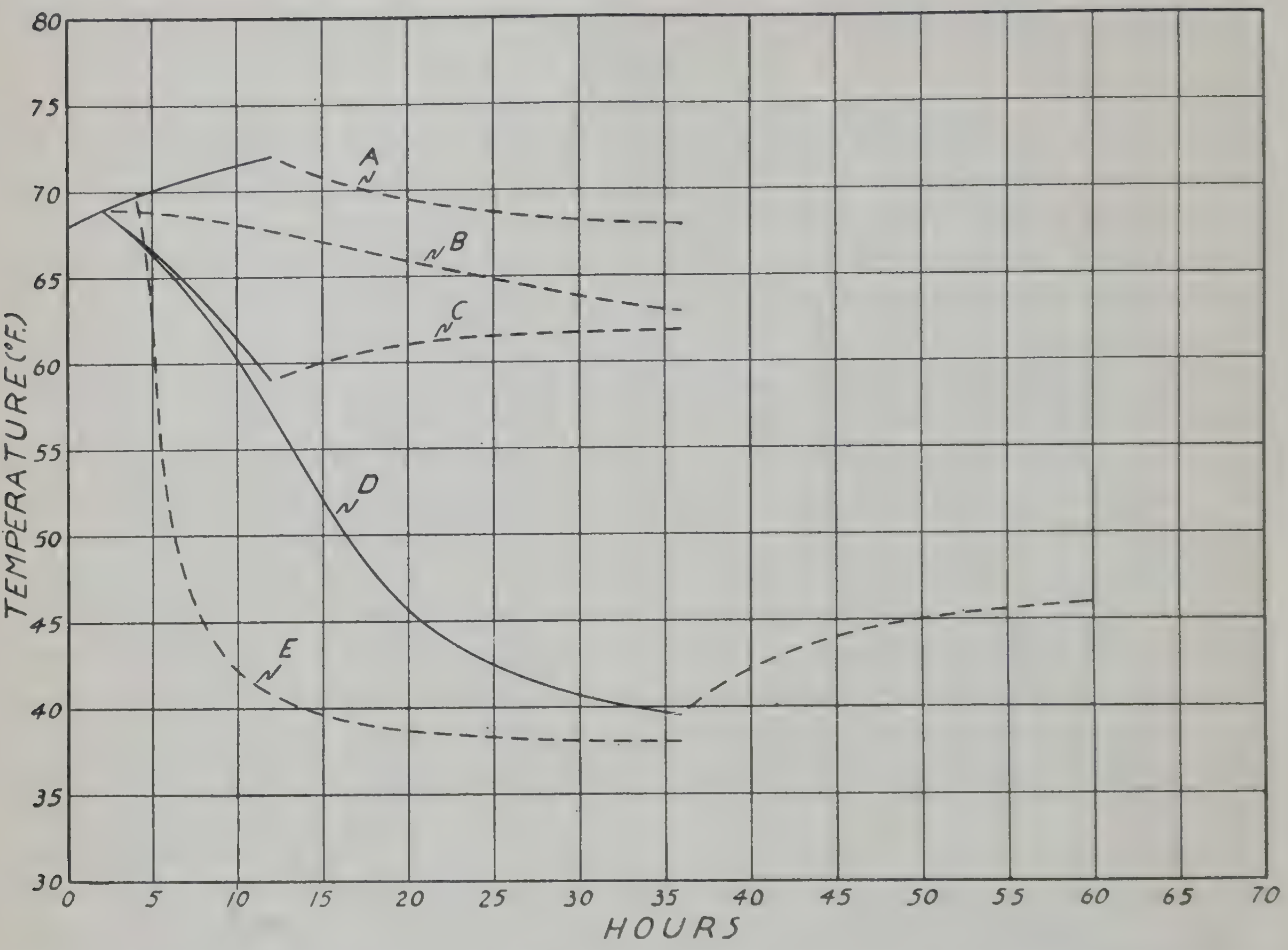

FIGURE 5. TEMPERATURE HISTORY OF LETTUCE UNDER DIFFERENT METHODS OF HANDLING AND SHIPPING

Solid lines represent the time before shipping; broken lines indicate the temperature during transit
A, lettuce shipped in field packs by truck without precooling
B, lettuce shipped in field packs by rail without precooling
C, lettuce in field packs partly precooled, shipped by truck
D, lettuce in field packs well precooled, shipped by truck
E, iceberg lettuce after packing and icing in centralized plants, shipped by rail or truck

for instance, that as a result of different handling methods employed, lot A had reached 25-per-cent, and lot B, 10-per-cent, deterioration when received on the market, inspection of these two lots at that time would show only a relatively small difference in appearance. Still it would be found that when both lots were kept subsequently under identical conditions, there would be a 15-per-cent difference in the time which elapsed before these lots became unsalable.

Truck and rail shipments. One of the first problems studied was the difference in the rate of deterioration of field-packed lettuce shipped by truck and by rail. Lettuce to be shipped in refrigerator cars usually was loaded two hours after cutting, whereas lettuce to be transported in trucks was held in a shed until late in the evening, when the load was assembled. This accounts for the fact that the difference in the temperature at loading time, on the average, was three degrees higher for truck shipments than for rail shipments (figure 5, lots A and B). This temperature difference became slightly larger during transit, probably because refrigerator cars are better insulated than most trucks and also because the cars were cooled before loading by filling the bunkers with ice on the preceding day. On arrival at the market the average temperature of rail shipments was 63° and that of truck shipments 68° F. The corresponding difference in the percentage of deterioration, as calculated from the complete temperature history, was very small. Lettuce arriving by rail had deteriorated to the extent of 21.6 per cent, while that received by truck had undergone 23.7 per cent of the complete deterioration process. These theoretical calculations agree with the fact that a careful inspection on the market never revealed any significant difference in the general appearance and condition of lettuce transported by these two methods. It is true that occasionally some lots received by truck were found to be in badly wilted condition. In most cases, this poor condition of the lettuce could be attributed to the fact that it had been unloaded early in the afternoon and had undergone rapid wilting while standing on the curb, sometimes exposed to direct sunlight.

Shippers have raised the question as to whether better refrigeration could be obtained in trucks by increasing the quantity of top ice usually applied. The fact that in every instance there was still some ice left in the trucks when they were unloaded indicates that additional top ice would have little or no effect on the temperature of the lettuce in transit. However, temperature records from different tiers in the same truck showed that a change in the method of icing is likely to result in better refrigeration. It was found that the average temperature in the top layer was 56° F., in the center it was 63° F., and at the bottom 66° F. Such a temperature relationship is the reverse of that commonly found in refrigerator cars. Apparently, the air circulation in a truck is reduced to a minimum unless the truck is equipped with a bunker or a false floor. As a result, the cooling effect is confined primarily to the top layers, because the lower tiers do not come into contact with the ice water or the cooled air. On the basis of these observations, it is logical to assume that the benefit from the ice applied could be increased considerably if it were added in two or three layers, which would bring it into close contact with all of the crates in the truck. Naturally, only snow ice could be used for that purpose because chunk ice would make tight packing of the load impossible. One shipper who followed this procedure of icing reported that this method is practical and results in an appreciable lowering of the average transit temperature.

Precooling experiments. Precooling lettuce has been adopted as a general practice by many growers in New York, in the belief that this procedure would provide a cheap and effective method of insuring the arrival of truck loads of lettuce in sound condition. It was also realized that the necessary quantity of top ice could be reduced considerably if the load had first been precooled. Because of the erroneous belief that a well-iced refrigerator car provides conditions for rapid cooling of lettuce, precooling in actual practice has been confined entirely to truck shipments.

Conflicting statements by shippers and receivers as to the relative merits of precooling called for a careful study of the effect of this practice on the transit temperature of the lettuce and its condition on arrival at the market.

In the course of these studies it became evident that in some cases fair results were obtained from precooling, while in others the effect was practically nil. On the basis of temperature records of many individual precooled shipments, it was relatively easy to trace the cause for failures whenever they were experienced. First of all, some growers and shippers did not realize that the rate of cooling lettuce in a cold-storage plant is exceedingly slow; at any rate, much slower than is generally believed. Also, they did not take into account the fact that during precooling, especially during the first half day of this process, deterioration still proceeds at a fairly rapid rate. Finally, some shippers had the erroneous belief that lettuce, once it has been precooled, remains at fairly low temperatures regardless of the temperature to which it is exposed after removal from cold storage.

Several laboratory and field experiments were carried out to determine exactly how long a period is required for effective precooling. Accurate temperature records were obtained for lots of lettuce held in commercial cold storage and in experimental rooms. Typical cooling curves for lots held at 32° and 35° F. are presented in figure 6. It will be noticed that the rate of cooling was nearly the same regardless of the type of cold room used for storage. As should be expected, the time for cooling to a definite temperature, 40° F. for instance, depended to some extent on the original temperature of the lettuce when first put into the cold rooms. As soon as the precooled lettuce was transferred to 70° or 80° F., reheating took place at a rapid rate. In fact, the rate of reheating was considerably more rapid than the corresponding cooling rate for the same temperature interval. This is easily explained by the fact that during the cooling process it is necessary not only to remove the field heat, but also the heat generated as a result of respiration. On the other hand, the process of reheating is accelerated by the same heat of respiration, which becomes more effective as the temperature of the lettuce rises. It is obvious, therefore, that whatever benefits are expected from precooling, they cease soon after the produce is transferred to a higher temperature.

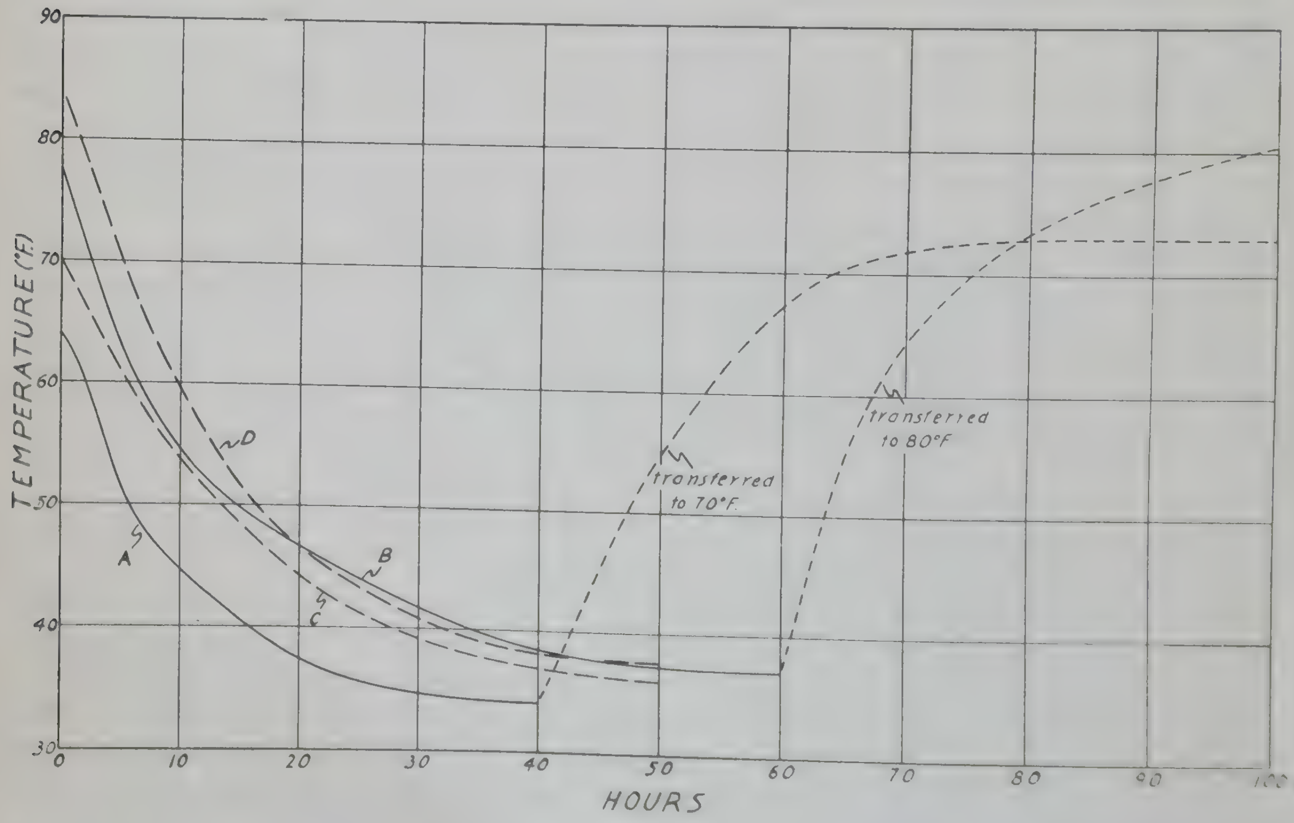

FIGURE 6. TEMPERATURE HISTORY OF LETTUCE DURING THE PRECOOLING PERIOD AND AFTER REMOVAL TO HIGHER TEMPERATURES

A and B, temperature changes in lettuce precooled in experimental cold-storage rooms held at a temperature of 32° and 35° F. respectively

C and D, cooling rate of lettuce held in commercial cold-storage plants at an average temperature of 35° F.

From these data, it must be concluded that to obtain effective precooling of the lettuce, the crates should remain in the cold room for a minimum of 30 hours. Under commercial conditions it is advisable, therefore, to hold lettuce, delivered at the cold-storage plant in the morning, until the evening of the following day. Actually, however, it was observed that in many instances the lettuce was loaded into the trucks the same day, sometimes less than 6 hours after it had been received at the cooling plant. The result was that the temperature of such lots had been reduced to an average temperature of 69° F. at the time of loading (figure 5, lot C). Consequently, the average transit temperature of these lots was only about 10 degrees less than that of lettuce which had not been precooled at all. As pointed out earlier, a 10-degrees reduction in the upper temperature range has little effect on the actual rate of deterioration of lettuce. Consequently, the calculated percentage of deterioration of lots handled in this manner had reached 19.9, as compared with 23.7 per cent for non-precooled lots.

The effect of precooling was more favorable if the lettuce was left in the cold-storage rooms for a period of 36 hours, at the end of which an average temperature of 40° F. was attained. Subsequent transit temperatures were correspondingly low, and at the time these thoroughly precooled lots arrived on the market they had an average temperature of 46° F. (figure 5, lot D). The corresponding degree of breakdown in these lots was 17.5 per cent. While this signifies a slightly better condition of properly precooled lots than that of lots A, B, and C, still the difference is relatively small. At any rate, it is smaller than one might expect on the basis of the low transit temperatures of lot D. This discrepancy is explained by the fact that properly precooled lots (D) arrived on the market 24 hours later than did those shipped without precooling (lots A and B) and those that had been partly precooled (lot C). It must be remembered that during the precooling period, even though the temperature is decreasing constantly, the process of deterioration still proceeds at an appreciable rate. In fact, it was calculated from the temperature records that during the entire precooling period alone, 11.0 per cent of the complete deterioration process took place.

Package-icing of lettuce. From the preceding discussion, it is apparent that the deterioration occurring between the time of harvest and the time the lettuce arrives on the market can be reduced effectively only if provisions are made to bring about a rapid drop in temperature of the lettuce soon after it is harvested. This can be accomplished most effectively by package-icing. The temperature history of such lots is represented by curve E in figure 5. It will be noticed that this method of handling brings about much more rapid cooling than can be obtained in a cold-storage room. Also, package-iced lettuce, whether shipped by rail or truck, usually reaches the market 24 hours earlier than does precooled lettuce. As a result, the average temperature of these lots on arrival at the market was only 38° F., and the corresponding percentage of breakdown was 9.5, which indicates a considerably slower deterioration rate than was observed for any of the other handling methods studied. Inspection for condition of the lettuce was in strict agreement with these results. The difference in appearance between precooled and nonprecooled lots was slight and in many instances barely noticeable. On the other hand, package-iced lots showed a distinct improvement in quality when compared with any of the other groups.

Effect of handling methods on the subsequent rate of deterioration. An evaluation of different handling and shipping methods should take into consideration not only the effect they have on the condition of the lettuce at arrival, but also the effect they have on the rate of deterioration during the subsequent period when the lettuce is in the hands of the wholesaler or retailer. It can be assumed that during an entire season different prices are obtained for two brands of lettuce showing the same general condition and quality when received on the market, but one of which consistently breaks down more rapidly in the retail store. This undoubtedly is one of the reasons why lettuce from California nearly always sells for a higher price than does lettuce grown locally, even though there may be little or no difference in the quality and appearance when unloaded on the market.

How different handling methods affect the subsequent rate of deterioration is indicated in table 1. After 24 hours, most lots reached a temperature varying from 76° to 81° F., depending on the particular treatment to which they had been subjected earlier. Only the package-iced lots showed a much slower rate of reheating, because of the presence of the ice in the package; this did not disappear entirely until the end of 30 hours. The cooling effect of the ice was sufficient to retard the reheating process so that the average temperature of these lots was only 47° F. after 24 hours. The corresponding percentage of deterioration at this time was calculated to be 14.0, whereas lettuce handled by any of the other methods had undergone 32.9 to 45.6 per cent of the total deterioration process.

TABLE I. TEMPERATURE AND PERCENTAGE OF COMPLETE DETERIORATION OF LETTUCE ON THE MARKET AS A RESULT OF DIFFERENT SHIPPING AND HANDLING METHODS

Method of handling	Method of shipping	At time of arrival		24 hours after arrival	
		Temperature	Deterioration	Temperature	Deterioration
		Degrees F.	*Per cent*	*Degrees F.*	*Per cent*
A. Field pack, not precooled	Truck	68	23.7	81	45.6
B. Field pack, not precooled	Rail	63	21.6	81	42.1
C. Field pack, partly precooled	Truck	62	19.9	80	39.9
D. Field pack, precooled to less than 40° F.	Truck	39	17.5	76	32.9
E. Packed in Los Angeles, crate and package-iced	Truck or rail	38	9.5	47	14.0

These comparisons of different shipping and handling methods are based on the observed temperature history of the various lots and also on the known relationship between temperature and rate of breakdown. It seemed desirable to check the results thus obtained by direct comparisons of the condition on arrival and the subsequent rate of breakdown of lots handled in different ways.

Actual inspection of lettuce on the market for condition agreed in general with the results obtained by means of indirect calculations. There were some exceptions, however, since it is difficult to compare the relative condition of two lots showing wide variations in other quality factors, such as the solidity of the heads. No significant differences could be detected in the general condition of lettuce shipped by rail or by truck; this includes both nonprecooled and partly precooled lettuce. Generally, lots which had been properly precooled appeared less wilted than others and were usually given a slightly higher rating. A very definite advantage of package-icing was invariably illustrated by the fact that such lots received on the market a day after loading seldom showed any visible signs of breakdown at all.

The subsequent rate of deterioration was investigated in another set of experiments. Lettuce of uniform quality was divided into three lots at the shipping point. One was shipped as field-pack without any further treatment; another lot was precooled for 36 hours; and a third one went through a packing plant and received the usual quantity of package ice. All lots were shipped to the market in trucks containing only lettuce which had been handled in the same way. As soon as the different lots arrived on the market they were inspected for condition and then stored in a back room of a commission house where an even temperature of about 78° F. was maintained. Twice daily, records were taken of the temperature of the lettuce and of the percentage of visible breakdown that had taken place. These records were based on an arbitrary rating system in which "9" signifies a condition equivalent to that of freshly harvested lettuce, and "1", a rating equal to a condition which would render the lettuce unsalable under ordinary conditions. The intermediate points of this rating system were based on the price that might be expected for lettuce of that particular condition, if other quality factors were disregarded.

The results of this study are presented in figure 7. Regardless of the initial treatment, there was little difference in the condition of the lettuce when it first arrived on the market. During the following three days, the precooled lot B and the nonprecooled lot C deteriorated at a fairly uniform rate. A slight difference in condition in favor of the precooled lot was maintained for about two days. Later, however, this difference disappeared gradually, and at the end of 70 hours both lots had become entirely unsalable. The deterioration rate of the lot which had been package-iced (A) followed an entirely different course. During the first 50 hours, the rate of breakdown was much slower than in lots B and C, undoubtedly because of the presence of ice in the package. Toward the end of the storage period, the rate of deterioration became more rapid; in fact, it exceeded that of the precooled and nonprecooled lots during the last day of storage. It is believed that the presence of free water from the melted ice was responsible for the acceleration of the deterioration process after the lettuce had reached the high temperature of the surrounding air. For practical purposes, the important point to consider is the fact that the rating of the package-iced lot did not drop below 7 until 52 hours after it had been received on the market. It must be assumed that under ordinary conditions the lettuce would have reached the consumer by that time so that the subsequent rapid breakdown is of little importance. When this experiment was repeated twice, slightly different values were obtained; however, they led to the same general conclusions as were obtained in the experiment described.

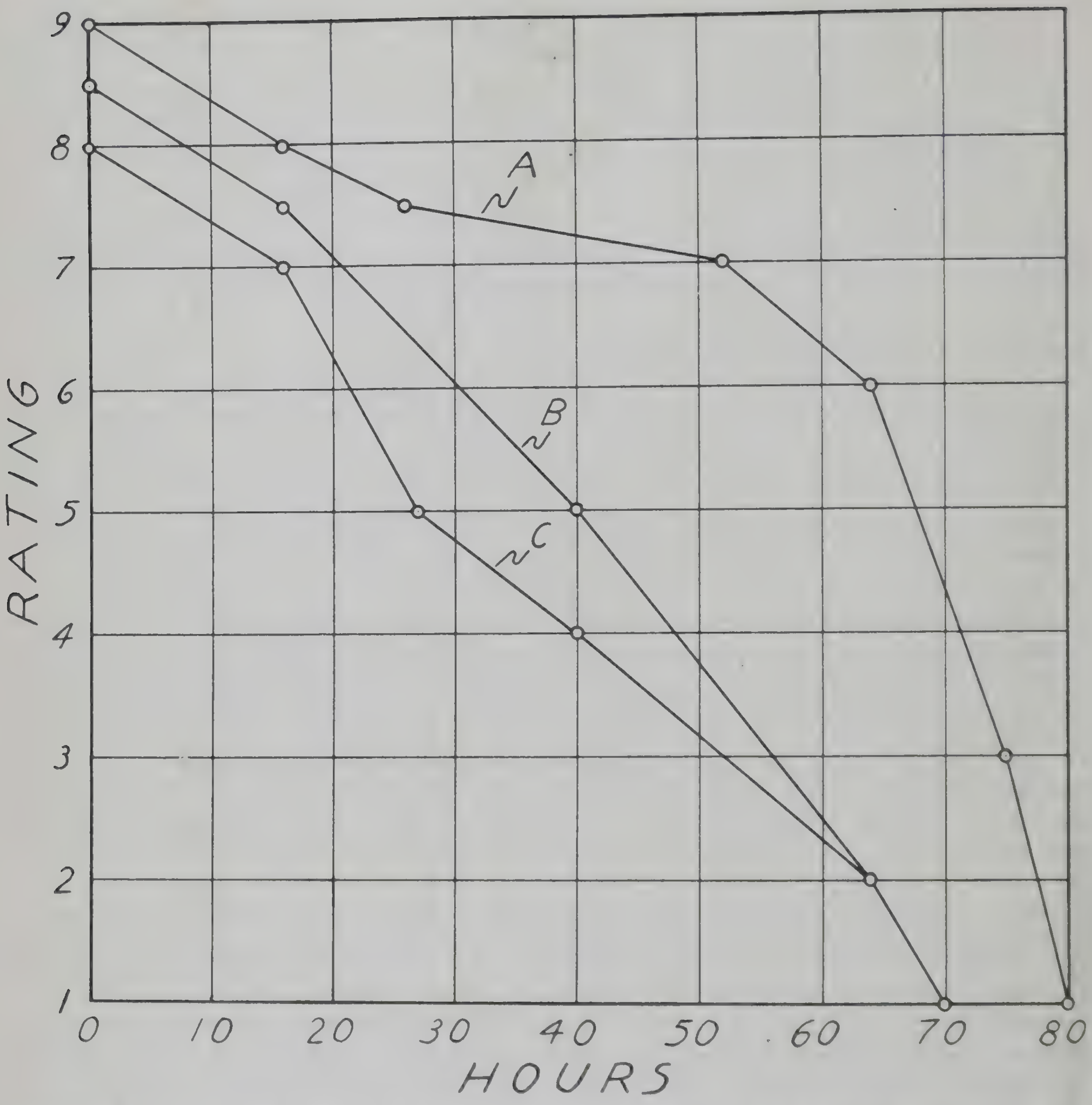

FIGURE 7. SALABILITY RATING OF ICEBERG LETTUCE HELD AT AN AVERAGE TEMPERATURE OF 78° F. AFTER ARRIVAL AT THE MARKET

A, lettuce package-iced before shipping
B, lettuce precooled for 36 hours before shipping
C, lettuce in field packs shipped without precooling

SUMMARY

Lettuce growers in New York differ widely in their opinion as to which methods of handling and transportation are most practical and economical. By far the greater part of the lettuce crop is marketed in field packs which are shipped to the market without grading or precooling. The trend toward a wider use of motor trucks as a means of transportation continues with a corresponding decline of rail shipments.

With the introduction of promising strains of iceberg lettuce several new packing plants have been established where facilities are available for effective grading and package-icing of the lettuce. Simultaneously, an increasing number of growers have adopted precooling as a general practice for all types of lettuce. These improved packing and handling methods have enabled many growers to compete successfully with California producers. At the same time, modern packing methods appreciably raise the cost of marketing and their use can be recommended only for high-quality lettuce. Market surveys have shown that no matter how fresh and crisp a head of lettuce appears, its compactness and freedom from defects is by far the most important factor in determining the price that the buyer will pay. Consequently, it is doubtful whether it is economically sound to expend additional money on improved handling methods for lettuce of inferior grade, which under any conditions will sell at a relatively low price.

With few exceptions, locally grown lettuce is trimmed less closely than California lettuce. Since trimming makes the head appear more compact, and because the buyer is more concerned about the firmness of the head than about its size, growers are advised to trim more closely than is the practice at the present time.

The degree of deterioration which lettuce has reached when it is received on the market depends primarily on the temperature to which it has been exposed after harvesting and also on the length of time that has elapsed between cutting of the heads and their arrival on the market. Consequently, the relative merits of different shipping and handling methods can be measured by following the temperature history of lots shipped and handled by the various methods.

After careful study of such temperature records and comparisons of the actual appearance of the lettuce on the market, it was concluded that there was no significant difference between the condition of lettuce shipped by rail and that of lettuce shipped by truck. It is true that some shipments made in poorly insulated trucks during exceedingly hot weather arrived in badly wilted condition, but such cases were exceptional. To judge from the temperature records taken within the truck when it arrived on the market, it appeared that the cooling effect of the ice could be increased considerably if it were spread over the crates in 2 or 3 layers instead of in a single layer on top of the load. This idea is confirmed by the experience of one grower who consistently followed this practice. Barring exceptional circumstances, the choice of rail or truck as means of transportation should depend primarily on the relative cost per package.

The beneficial effect of precooling has been overrated by some growers and shippers. Precooling is less effective than might be expected because the cooling rate of lettuce is exceedingly slow when the lettuce is held in a cold-storage room. Ordinarily, a minimum of 30 hours is required to lower the temperature of lettuce to 40° F. During this intervening period deterioration still proceeds at an appreciable rate. Also, the effect of precooling ceases soon after the crates are removed to a higher temperature. Still, this practice has some advantages which make its use advisable under certain conditions. First of all, it is the only practical method for obtaining low transit temperatures for Boston lettuce, which cannot be package-iced. Also, it makes it possible to reduce the quantity of top ice used in truck loads; and, during exceptionally hot weather, precooled truck loads are likely to reach the market in less wilted condition than that of others which are protected against heating by top ice alone. Under these conditions, the relatively small expenditure of 5 cents per crate for precooling seems justified.

No other handling method can compare with package-icing in effectiveness. Whether shipped by rail or truck, the temperature of package-iced lettuce drops to less than 40° in 12 hours. As a result, the condition of such lettuce is always better than that of lettuce which has been shipped in field packs. Moreover, the rate of reheating of iced packages is very slow, so that the advantage of package-icing becomes even more pronounced a day or two after the lettuce reaches the market. In addition, package-icing is easily combined with other recommended practices, such as the elimination of culls, careful trimming, and selling under a definite brand. In a few instances, New York iceberg lettuce has sold on a par with California lettuce on the New York City market in recent years, and it seems certain that this goal would never have been achieved if the growers had not followed improved methods of grading, packing, and icing in marketing their crop.

RECOMMENDATIONS

1. Closer trimming of lettuce than is now practiced in New York. In this way the appearance of the heads can be improved greatly without additional cost.
2. Precooling in local cold-storage plants for Boston, romaine, and low-grade iceberg lettuce. To obtain effective precooling, the crates should be left in the cold rooms for at least 30 hours before loading.
3. Better refrigeration of truck loads by distributing snow ice throughout the load in two or three layers, rather than in a single layer on the top of the load.
4. In truck shipping, the use of well insulated trucks.
5. Scheduling of truck shipments so they will arrive on the market not earlier than a few hours before the market opens.
6. Grading, packing, and icing in a centralized packing house for iceberg lettuce of high quality. This method insures a uniform quality and a better condition of the lettuce after arrival on the market than can be obtained by any other handling method available.

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EXPERIMENTS WITH NEW ELECTRIC DEVICES FOR PASTEURIZING SOILS[1]

A. G. Newhall

The many advantages of heat as an agent for disinfesting soils, particularly soils that have become unproductive from the accumulation of parasitic fungi, nematodes, weed seeds, and insect pests, have long been recognized. Heat is quick and transient, but is very thorough. It destroys all pests. Many growers of flowers and vegetables who do not have equipment to steam-"sterilize" are finding that limited quantities of soil can be economically and satisfactorily "pasteurized" with some sort of electrical device.

METHODS OF SOIL-PASTEURIZING

DIRECT-HEATING METHOD

Two general methods involving the use of different kinds of electrical equipment have been developed. In one, the direct-heating method, the soil-resistance principle is employed in which the current passes directly through the soil from one metal plate, or electrode, to another. Charles W. Wildebour appears to have been the first to employ the method in America (Anonymous, 1932). He and Glen Cushing worked in cooperation with C. F. Doucette, then in charge of the entomological laboratory of the United States Department of Agriculture at Sumner, Washington. They heated 20 square feet of bench soil at a time, from 60° to 180° F. in about two hours, with 70 kilowatt-hours on 230-volt alternating current. A year later, Fee (1933) described the successful use of vertical plates in a greenhouse bench where 15 square feet was treated at a time on a 30-ampere 230-volt alternating-current line. Similar results were obtained in the same year by Krewatch and Kable (1933), who made a comprehensive report on the procedure and pointed out a number of the limitations and difficulties involved in applying this method to the treatment of bench soil and ground beds.

A box type of pasteurizer also was developed in the Washington experiments described by Scott (1932). This was capable of raising the temperature of about ¾ cubic foot of soil to 180° F. in 4½ minutes by employing vertical metal blades (electrodes) 2 inches apart in a box 12 by 18½ inches in size and 5½ inches deep. Blauser (1934?, 1935) improved on the construction of this cabinet type by employing but two horizontal electrodes 10 inches apart, in place of numerous vertical ones. He was able to obtain satisfactory temperatures with the expenditure of less than 1 kilowatt-hour per cubic foot of soil. He stated that resistance to the current was directly proportional to the distance apart of the electrodes and inversely proportional to their area. As a standard size for a pasteurizer to be used on 230-volt alternating current and where a maximum service of 50 amperes was available, he settled on one 24 by 36 inches in size and 10 inches deep; but he stated that if a maximum of only 25 amperes was available, the dimensions should be cut to 24 by 18 by 10 inches. If the depth was reduced to 5 inches, the demand would then be equal to that of the larger pasteurizer while the volume would be cut to one-fourth; and hence the time required to reach the end point, and the total current consumed, would also be but one-fourth of those with the larger box. The work of Tavernetti (1935) confirmed the results obtained by others.

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[1] This is one of several agricultural-research projects undertaken with funds supplied by the Empire State Gas & Electric Association.

Newhall and Nixon (1935) made a study of the direct-heating (Ohio) type of cabinet pasteurizer (figure 1), and found that the current consumed per cubic foot of soil per degree rise in temperature ranged from 22 watts for sand to 28 watts for muck with its higher water content. Greater efficiency than this has recently been obtained by Cruz (1939), who employed a constant-current transformer which automatically stepped up the voltage whenever the charge of soil had a relatively high resistance (as sand) and reduced the voltage when a soil with high conductivity (as muck or compost) was being heated. In general, the experiments in America clearly indicate that a cubic foot of soil can be heated sufficiently to kill pathogenic microorganisms and weed seeds with about 1 kilowatt-hour of electricity when 230 volts are used, and with even less if higher voltages can be employed.

In Europe, similar experiments have been conducted with direct-heating equipment along parallel lines with those in America. Dix and Rauterberg

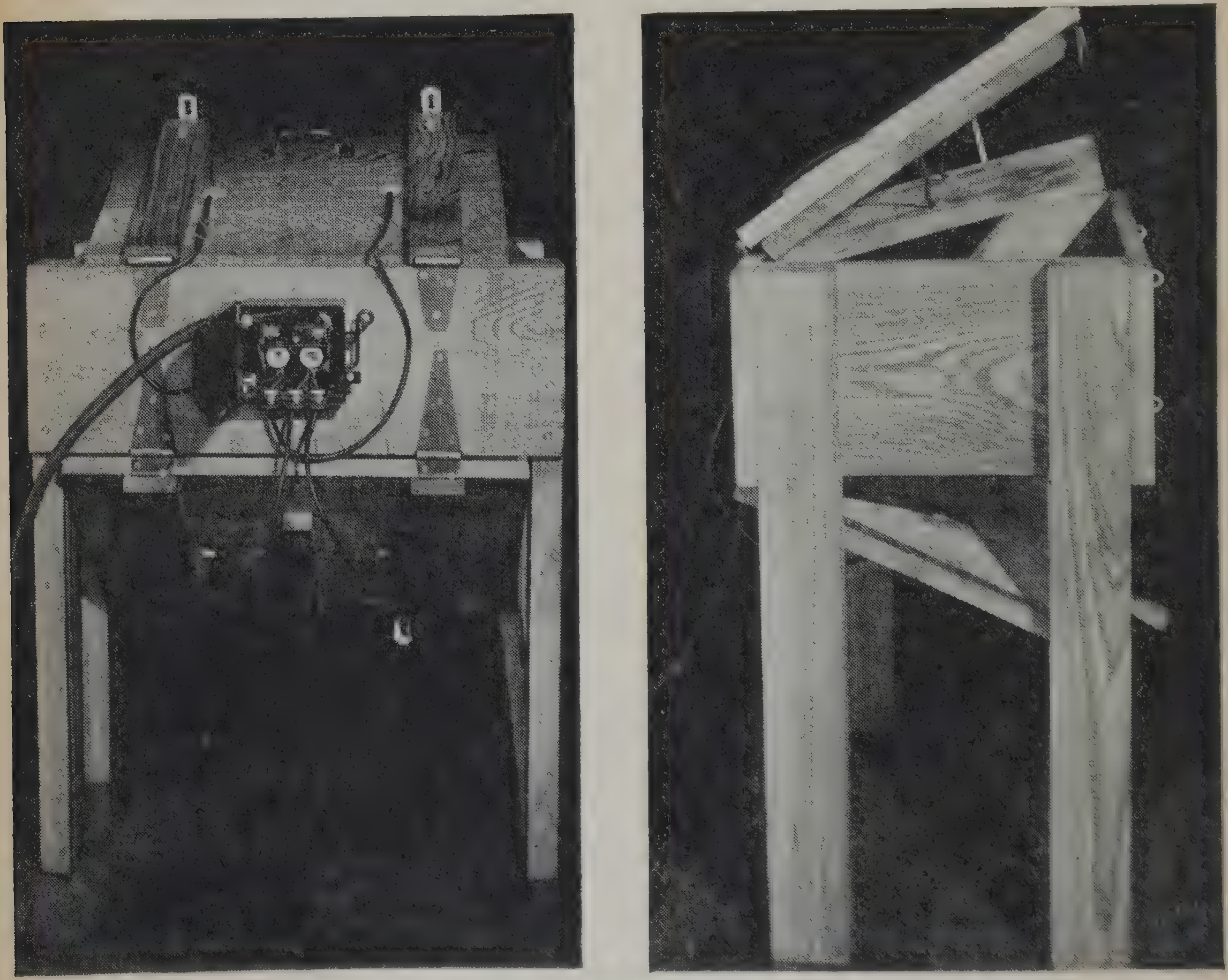

FIGURE 1. A DIRECT-HEATING SOIL PASTEURIZER, OHIO TYPE, WITH A CAPACITY OF 2.4 CUBIC FEET

The current passes directly through soil from one horizontal electrode to another. On 230-volt alternating current, it takes from 25 minutes to 6 hours to treat a charge of soil. The current demand is variable, and exceeds 5 kilowatts under some soil conditions

(1933), in Germany, used a three-phase circuit and a transformer with a capacity of 3.6 to 60 amperes at voltages between 2750 and 200. Seven parallel vertical electrodes were placed in the soil at intervals varying between 8 and 78 inches in different experiments. The best results were said to have been obtained when electrodes were approximately 20 inches apart and a 500-volt current was employed. By using strong currents for relatively short periods of time, greater economy was obtained. Thus a cubic yard of soil could be brought up to 70° or 80° C[2] with 9 to 16 kilowatt-hours, or less than ½ kilowatt-hour per cubic foot.

Both the American and the European experiments have shown that success with the vertical-plate method of direct heating requires a transformer, which is costly, that certain hazards to life and loss of current are hard to avoid, and that unless considerable labor and careful attention to details are employed uniform results cannot be expected. As a consequence, the vertical-plate direct-heating method has not found favor with practical growers.

Experiments with horizontal electrodes in a cabinet-type pasteurizer were conducted in Holland by Kroft and Groen (1933). Muyzenberg and Rijn (1937) then studied the device more thoroughly with respect to the effect of electrolytes, moisture, and compression on the conductivity of sand and soil. Their figures for current consumption were high—from 1.6 to 4+ kilowatt-hours per cubic foot—but their final temperatures were also rather high (99° C.).

Certain objectionable features of the direct-heating method include hazards to the operator, the variable and often very high demand made on the service line, and the care required in loading the chamber with soil to get uniformity in packing, in moisture content, and in contact between soil and electrodes, not to mention the frequent necessity of adding some dilute electolyte solution (sodium or potassium nitrate or sulfate) to increase the conductivity of sand. Taken all together, these are believed by many to outweigh the advantages of economy of construction and speed of operation pertaining to the direct-heating type of cabinet.

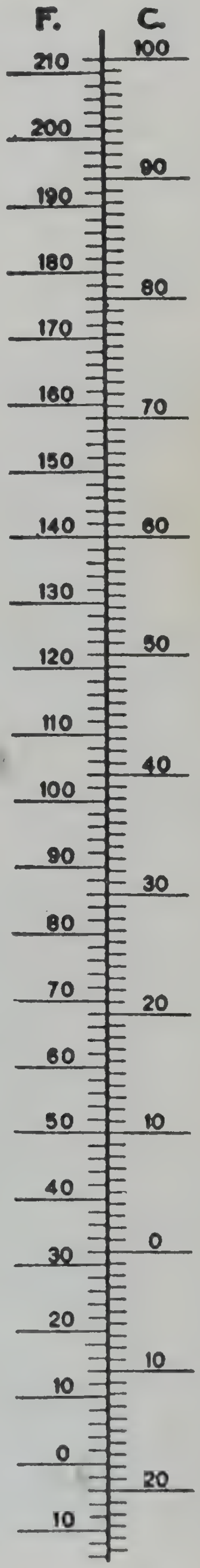

FIGURE 2. FAHRENHEIT-CENTIGRADE CONVERSION SCALE

INDIRECT-HEATING METHOD

The other general method of soil-heating employs the heating-element principle in which the current passes through covered, resistance, heating units properly spaced to impart their heat to the soil by thermal conductance. Cabinet pasteurizers operating on this principle, first described by Carney (1932) and further tested by Horsfall (1935) and by Newhall and Nixon (1935), have become known as the New York type (figures 3 and 4).

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[2] A centigrade-Fahrenheit temperature-conversion scale is shown in figure 2.

Newhall and Nixon found this kind of pasteurizer capable of heating soils to satisfactory temperatures (70° C.) with the expenditure of electric energy varying between 1.0 and 1.3 kilowatt-hours per cubic foot of soil treated, depending on the kind of soil, the initial temperature, and the moisture content. They concluded that the sum total of the advantages and disadvantages of the two general methods of pasteurizing was in favor of the indirect, because of its greater safety and simpler operation. They built cabinets holding up to 3 or 4 cubic feet of soil for $20 to $30, and

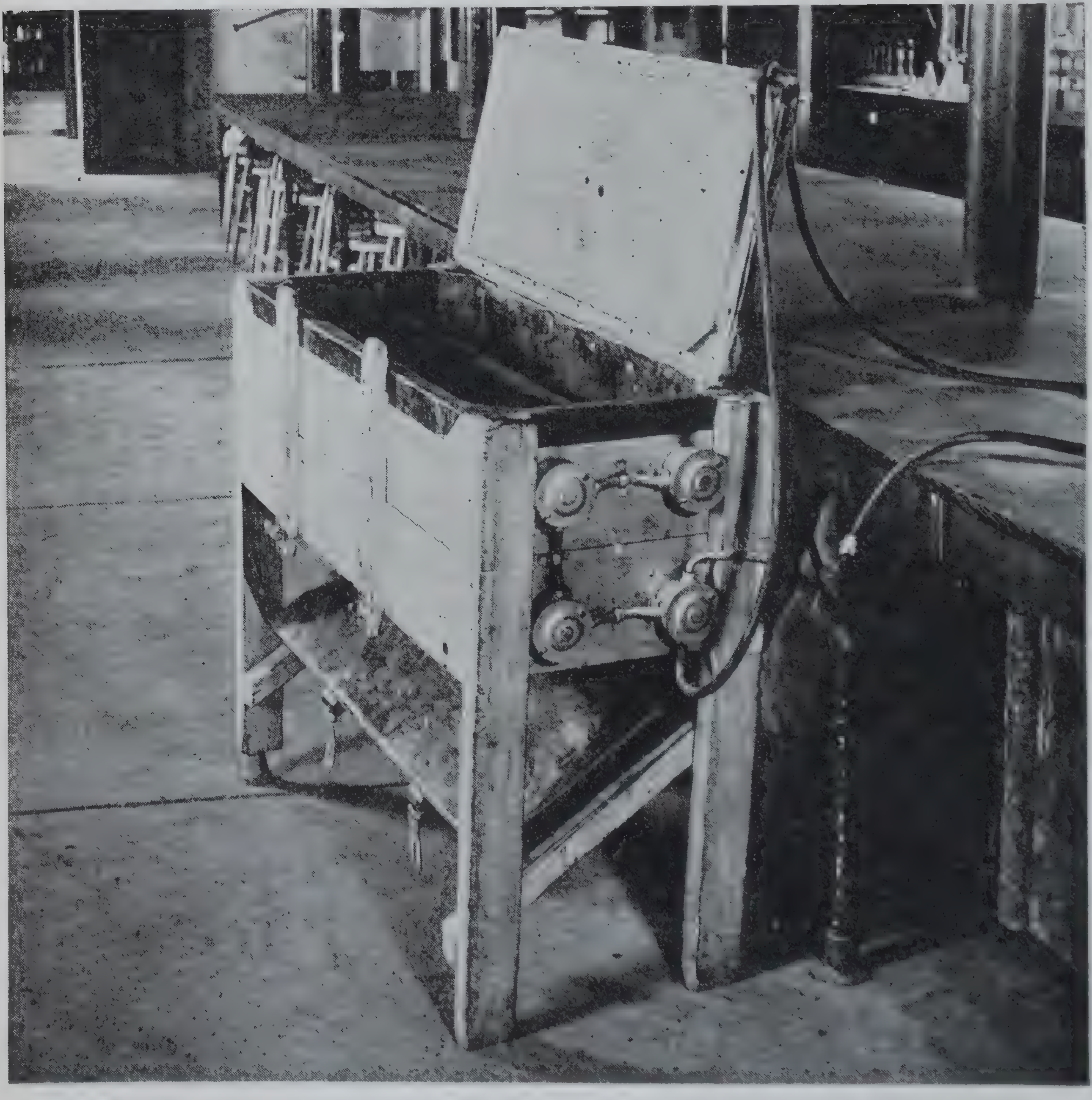

FIGURE 3. AN INDIRECT-HEATING SOIL PASTEURIZER, NEW YORK TYPE, WITH A CAPACITY OF 5 CUBIC FEET

This may be used on either 115- or 230-volt alternating current. Pipe-type space heaters with a constant-current demand of 1600 watts, are employed. It takes 4 to 5 hours to treat a charge of soil. The pasteurizer is lined with copper and insulated with composition board and has been in use for over four years without repair

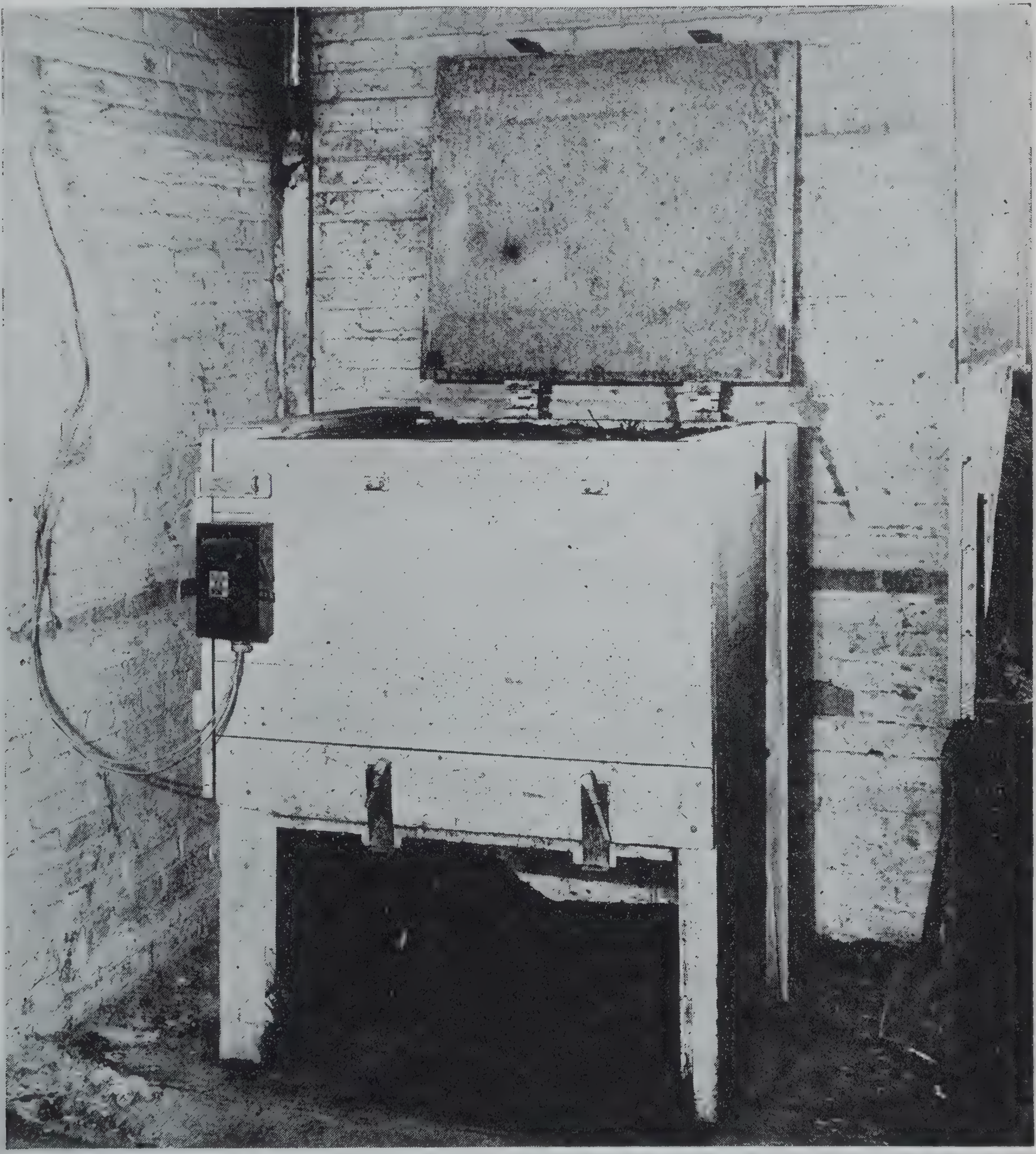

FIGURE 4. A POPULAR, SERVICEABLE, INDIRECT-HEATING SOIL PASTEURIZER, NEW YORK TYPE, WITH A CAPACITY OF ½ CUBIC YARD

This is equipped with "Calrod" heaters rating 3000 watts, and may be used on either 115- or 230-volt alternating current

assembled one holding ½ cubic yard for $67. Since 1931, when these were originally designed, there have probably been more than 100 such pasteurizers, of different sizes, purchased or built by growers in New York and neighboring States[3]. The largest are believed to hold 1 cubic yard, while the most popular seems to be the ½-cubic-yard size which operates on either 115 or 230 volts and has a connected load of 3000 watts, or 222 watts per cubic foot.[4]

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[3] From information supplied by manufacturers.

[4] Since these experiments were completed, a handy-sized portable electric pasteurizer holding 2 bushels of soil has been placed on the market. It is shaped like a large suitcase, contains one 750-watt Calrod heater, and has been giving satisfactory service in the Department of Entomology and Limnology at Cornell University. This pasteurizer is illustrated in figure 9.

The matter of the wattage required and the proper spacing of the heaters was studied by Newhall and Nixon. They found that a considerable leeway is permissible in this respect. With pipe-type heaters of ¾-inch galvanized iron, which can be obtained in almost any desired length and wattage rating,[5] good results were obtained when the heat flux per square inch of heater surface varied between 2.12 and 2.45 watts. Heaters should be so rated and so spaced as to deliver from 200 to 300 watts per cubic foot of soil, and no portion of the soil should be more than 8 inches from a heater.

THERMAL DEATH-POINTS OF PATHOGENIC MICROORGANISMS

In a former publication the author gave evidence that in the presence of ordinary soil moistures a final temperature of 70° C. is high enough to kill a variety of pathogenic microorganisms, including members of such genera as Rhizoctonia, Sclerotinia, Phytophthora, Fusarium, Heterodera, and Erwinia, in less than an hour (Newhall and Nixon, 1935). Blauser (1935) concluded that 60° C. is high enough to kill nematodes (Heterodera) and most weed seeds, but that 65° is required to kill the Fusarium causing tomato wilt. Horsfall (1935) has noted the efficacy of long-time low-temperature treatment for damping-off control, 45° to 55° C. having been found high enough in some cases where an overnight treatment was made.

To test the supposition that 60° C. is a sufficiently high end temperature for damping-off control, a number of flats of soil known to possess damping-off organisms were heated in a Nixon dairy-utensil sterilizer (described later) until the following temperatures were reached: 40°, 45°, 50°, 55°, 60°, and 95° C. Each flat was subsequently sown with vegetable seeds, and records of damping-off were kept. The results indicated that heating

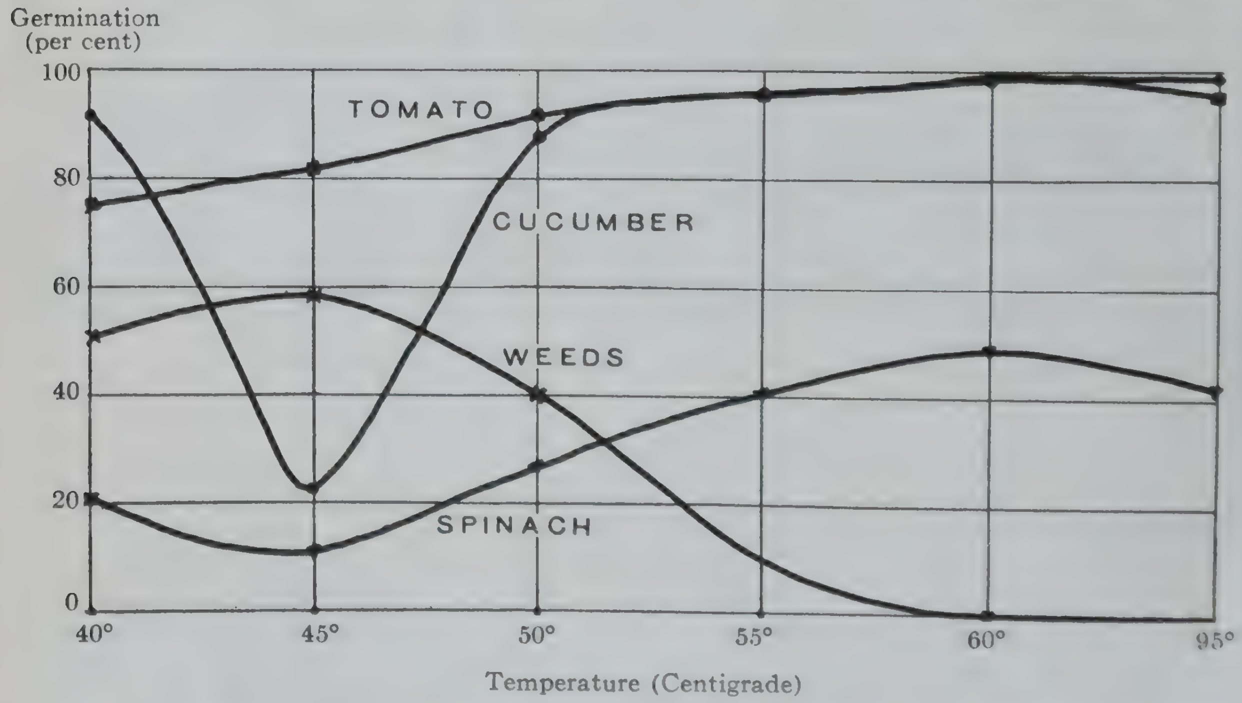

FIGURE 5. EFFECT OF HEATING LOAM SOIL TO CERTAIN FINAL TEMPERATURES, ON DAMPING OFF OF SOME VEGETABLE SEEDS AND ON GERMINATION OF WEED SEEDS

The germination in untreated soil was as follows: spinach, 13 per cent; tomato, 77 per cent; cucumber, 95 per cent; weeds, 45 per flat to 60° was as effective as was heating to 95°. Perhaps the time factor is of importance here, as it took three hours to attain the maximum temperature (figure 12, page 21). Most of the weed seeds were apparently destroyed when the temperature stopped at 60°, although the legumes and Capsella were exceptions and probably there are other exceptions. Weeds found in the checks included Amaranthus, Anthemis, Barbarea, Capsella, Cerastium, Lamium, Oxalis, and Stellaria.[6] The data from these tests are summarized graphically in figure 5. A point of some interest is the apparent increase in damping-off of spinach and cucumber, and in the germination of weed seeds, by heating the soil to only 45°. Such treatment rendered conditions worse than in the checks, although there have not been a sufficient number of trials to warrant assuming this to be generally true. Substantiation of the idea that a final maximum temperature of 60° is sufficient for damping-off control is presented in figure 6, in which stands of cucumbers, tomatoes, and spinach are shown in soil heated to three temperatures as compared with an unheated check.

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[5] Hynes & Cox Electric Corporation, Albany, New York.

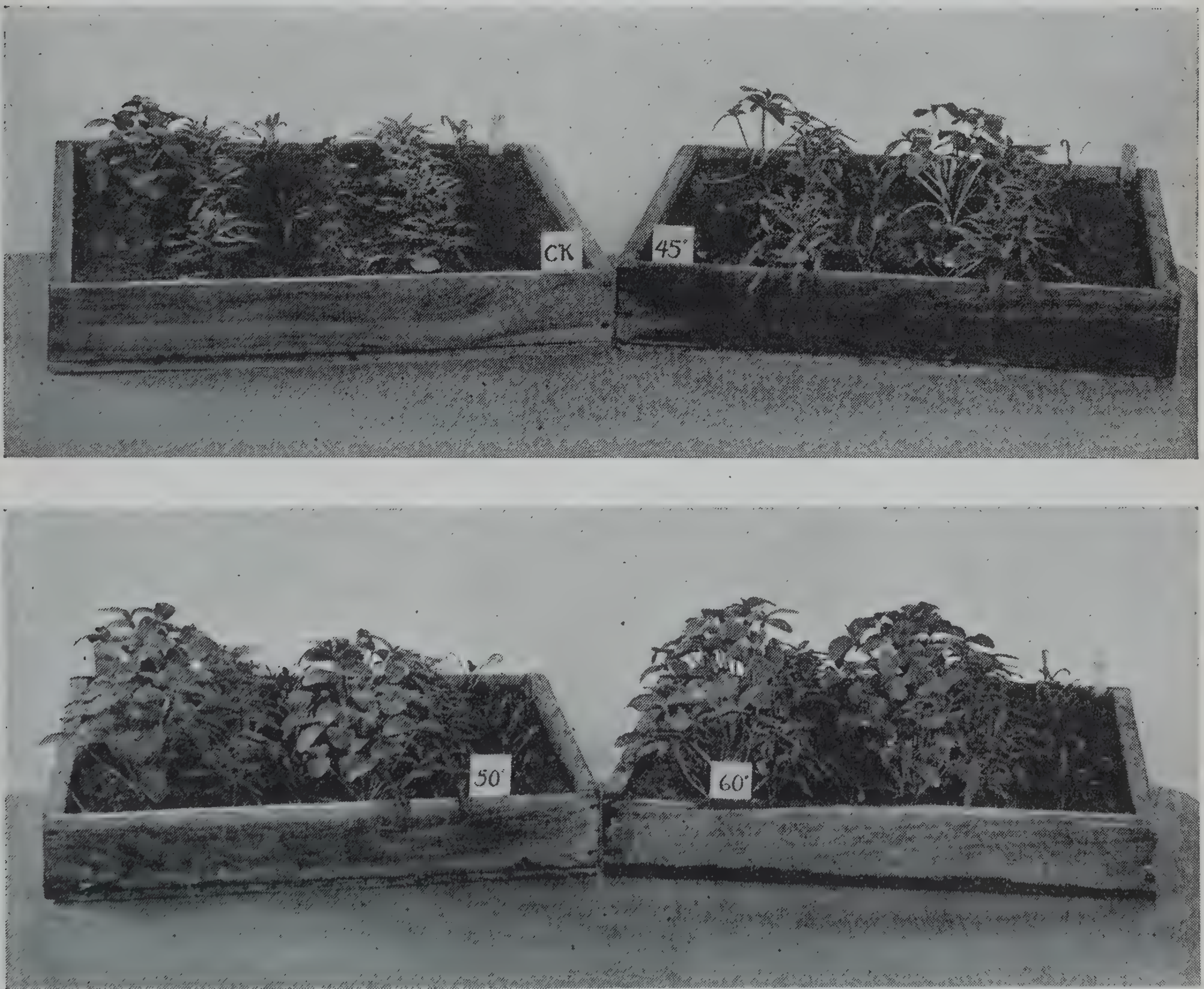

FIGURE 6. STANDS OF REPLICATE PLANTINGS OF CUCUMBERS, TOMATOES, AND SPINACH, IN SOILS HEATED TO THE FINAL MAXIMUM TEMPERATURES INDICATED (45°, 50°, AND 60° C.) IN THE NIXON DAIRY PASTEURIZER

No damping-off occurred in the soil heated to 60° C., though some was present in the samples brought to 50° and 55° C.

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[6] Identification of weeds was done by Professor W. C. Muenscher, of the Department of Botany at Cornell University.

Further confirmation of this important generalization, that effective soil treatment requires heating only to 60° C., is presented in the form of a table of thermal death-points of a number of microorganisms, other than bacteria, of variable pathogenicity (table 1). Examination of these data show that few fungi can withstand 65° C. even for 10 minutes. Sclerotia are no exception. Some of the molds which may be wet with difficulty are more resistant. Turning for a moment to bacteria, Elliott (1930) gives data on the thermal death-points of 102 bacterial plant pathogens, of which only 4 lie above 59° and none is above 69°.

TABLE 1. THERMAL DEATH-POINTS OF A NUMBER OF MICROORGANISMS OF VARIABLE PATHOGENICITY

Pathogen	Form	Temperature (C.)	Time (minutes)	Authority
Actinomyces scabies	Conidia	54°	10	Lutman and Cunningham (1914)
Alternaria solani	Conidia	45°	—	Rands (1917)
*Aspergillus niger**	Spores	55°	30	Wallace and Tanner (1931)
Botrytis cinerea	Mycelium and spores	55°	15	Zumstein (1936)
Botrytis cinerea	Conidia	50°	10	Smith (1923)
Cercospora apii	Mycelium and spores	52°	10	Klotz (1923)
Cladosporium fulvum	Spores	70°	1	Bewley and Buddin (1921)
Colletotrichum lindemuthianum	Mycelium	50°–52°	10	Muncie (1917)
	Spores	46°–48°	10	Muncie (1917)
C. oligochaetum	Spores	60°	1	Bewley and Buddin (1921)
C. lini	....	50°	30	Vladimirskaya (1930)
Diaporthe batatatis	Conidia	48°–49°	10	Harter and Field (1913)
Ditylenchus dipsaci	Larvae	43.5°	46	Ramsbottom (1918)
D. dipsaci	Larvae	48.5°	15	Ramsbottom (1918)
D. dipsaci	Larvae	52.5°	11	Ramsbottom (1918)
D. dipsaci	Larvae	57.5°	5	Ramsbottom (1918)
Fusarium eumartii	Mycelium and spores	55°	15	Zumstein (1936)
F. lycopersici	Mycelium and spores	65°	10	Zumstein (1936)
F. moniliforme	Conidia	70°	10	Merrill (acc. Hartley, 1921:28)
F. oxysporum	Mycelium	58°–59°	5	Wood (1939)
Helminthosporium sativum	Mycelium and spores	54°	10	Christensen (1926)
Heterodera marioni	All stages	48°	10	Newhall (1930)
Macrosporium solani	Mycelium and spores	50°	5	Zumstein (1936)
Marssonina panattoniana	Conidia	40°	10	Brandes (1918)
Mucor species†	Conidia	57°	30	Thom and Ayers (1916)
*Oidium lactis**‡	Spores	60°	30	Wallace and Tanner (1931)
Penicillium species§	Conidia	60°	30	Thom and Ayers (1916)
Phoma apiicola	Spores	49°	10	Bennett (1921)
Phytophthora citrophthora	Mycelium and zoospores	43.3°	5	Klotz (1940)
P. parasitica	Mycelium and spores	60°	1	Bewley and Buddin (1921)
P. cryptogea	Mycelium	50°	1	Bewley and Buddin (1921)
Plasmodiophora brassicae	....	60°	30	Vladimirskaya (1930)
Pythium debaryanum	Mycelium	40°	10	Zumstein (1936)
P. debaryanum	Mycelium and spores	65°	10	Merrill (acc. Hartley, 1921:28)
Rhizoctonia (=Corticium centrifugum)	Sclerotia in water	50°	50	Watanabe (1933)
C. centrifugum	Sclerotia in air	50°	60	Watanabe (1933)
C. centrifugum	Mycelium in water	45°	30	Watanabe (1933)
C. centrifugum	Mycelium in air	45°	20	Watanabe (1933)
Rhizoctonia crocorum	Mycelium	45°–48°	60	Newton (1931)
R. solani	Mycelium	45°–60°	60	Newton (1931)
R. solani	Sclerotia	55°–60°	60	Newton (1931)
Rhizopus nigricans	Spores	54.5°	30	Thom and Ayers (1916)
*R. nigricans**	Spores	50°	20	Wallace and Tanner (1931)
Sclerotinia sclerotiorum	Sclerotia	48°–50°	5	Joshi (1924)
S. delphinii	Sclerotia	50°	10	Zumstein (1936)
S. rolfsii	Sclerotia	50°	10	Zumstein (1936)
Septoria lycopersici	Spores	52°	10	Levin (1916)
S. apii	Mycelium	44°	10	Cochran (1932)
S. apii-graveolentis	Mycelium	42°	10	Cochran (1932)

*Suspended spores in dilute salt solution. Longer time sometimes needed in sugar solutions.
†Four species with thermal death-point below 57° C.
‡Survived 60° C. for 30 minutes. No survival at 62.8° according to Thom and Ayers (1916).
§Twenty-three species with thermal death-point below 60° C.

Valleau, Karraker, and Johnson (1926) found that heating soil to 65° C. for 15 minutes was sufficient to kill a Fusarium and a "Pythiumlike" organism causing root-rot of corn.

In studying the diseases of mushrooms, several workers recently have made pertinent observations on time-temperature conditions lethal to certain pathogens attacking this crop. Lambert (1930) found mycelium and chlamydospores of *Mycogone perniciosa*, the cause of "bubbles", to be killed in one hour at 50° C. and in six hours at 42° C.; artificially infested soil was rendered safe after a six-hour treatment at 45° C. Ware (1933) found that *Verticillium Malthousei* (brown spot) was killed in six hours at 40° C. Beach (1937) found that the following organisms did not survive soil temperatures fluctuating between 115° and 120° F. (46° and 49° C.) if such temperatures were maintained for sixteen to twenty-four hours: *Bacterium* sp. (brown blotch), *Cephalothecium* sp. (casing mold), *Dactylium* sp. (mildew), *Monilia fimicola* (white plaster mold), *Mycogone perniciosa* (bubbles), *Trichoderma koningi* (green mold), and *Verticillium* sp. (brown spot); spores of certain species of Penicillium and Aspergillus, however, survived six-hour exposures in a water bath at 140° F. (60° C.). Lambert (1932) reports that the spores of *Pseudobalsamia microspora* (truffle) survived 82° C. for five hours, and Beach found them to survive a 2-day heating in compost at 57° C. Beach concludes that 120° F. (49° C.) is sufficient to kill the more important harmful fungi in mushroom beds during the rather long period of heating attending the composting process, while 130° F. (54° C.) is preferable where insects must be driven out. This latter temperature, however, may be insufficient to kill *Pseudobalsamia microspora* (truffle), *Chaetomium olivaceum* (olive-green mold), and *Myriococcum praecox* (brown plaster mold) which are more resistant to heating.

Henrici (1930) mentioned the importance of moist heat as against dry heat in the destruction of molds. He stated that spores of *Monilia sitophila*, if wet, are killed in 5 minutes at 72° C., but if dry they require a 30-minute heating at 120° C. As the spores are not easily wetted, they may survive the baking process within a loaf of bread dough, where the temperature may not attain 100° C. Thom and Ayers (1916) also showed that in order to kill some molds dry heat must be twice as high as moist heat. Watanabe (1933) showed that whereas dry air aids in destroying mycelium of fungi, it hinders the destruction of resting organs such as sclerotia of Rhizoctonia.

Murphy and M'Kay (1926) showed that the perennial mycelium of *Peronospora destructor* in onion bulbs can be killed by heating the onions to 43° C. for a period of eight hours. Ramsbottom (1918) found that the eelworm *Ditylenchus dipsaci* (*Tylenchus dipsaci*) is destroyed by immersion of affected narcissus bulbs in water at 43.5° C. for two to four hours.

It is therefore the exception, rather than the rule, for fungus, nematode, and bacterial protoplasm to withstand temperatures between 60° and 65° C., even for a few minutes, under moist conditions. Since insect life also cannot withstand such temperatures and many of the most common plant viruses are destroyed in this range[7], and since most weed seeds are believed to be killed below these temperatures, the author chose 65° C. as the minimum end-point soil temperature to be sought in the experiments described in the following pages.

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[7] Exceptions are some which occur in tobacco and tomato.

EXPERIMENTS WITH INDIRECT-SOIL-PASTEURIZING DEVICES

ATTEMPTS TO USE AN ORDINARY SOIL-HEATING CABLE

Even the most successful electric soil pasteurizers thus far designed have the objectionable feature of requiring the soil to be handled once when it is put into the device, and again when it is removed to its permanent site. This situation has led to a search for ways of treating soil in benches and ground beds, without the labor of moving it.

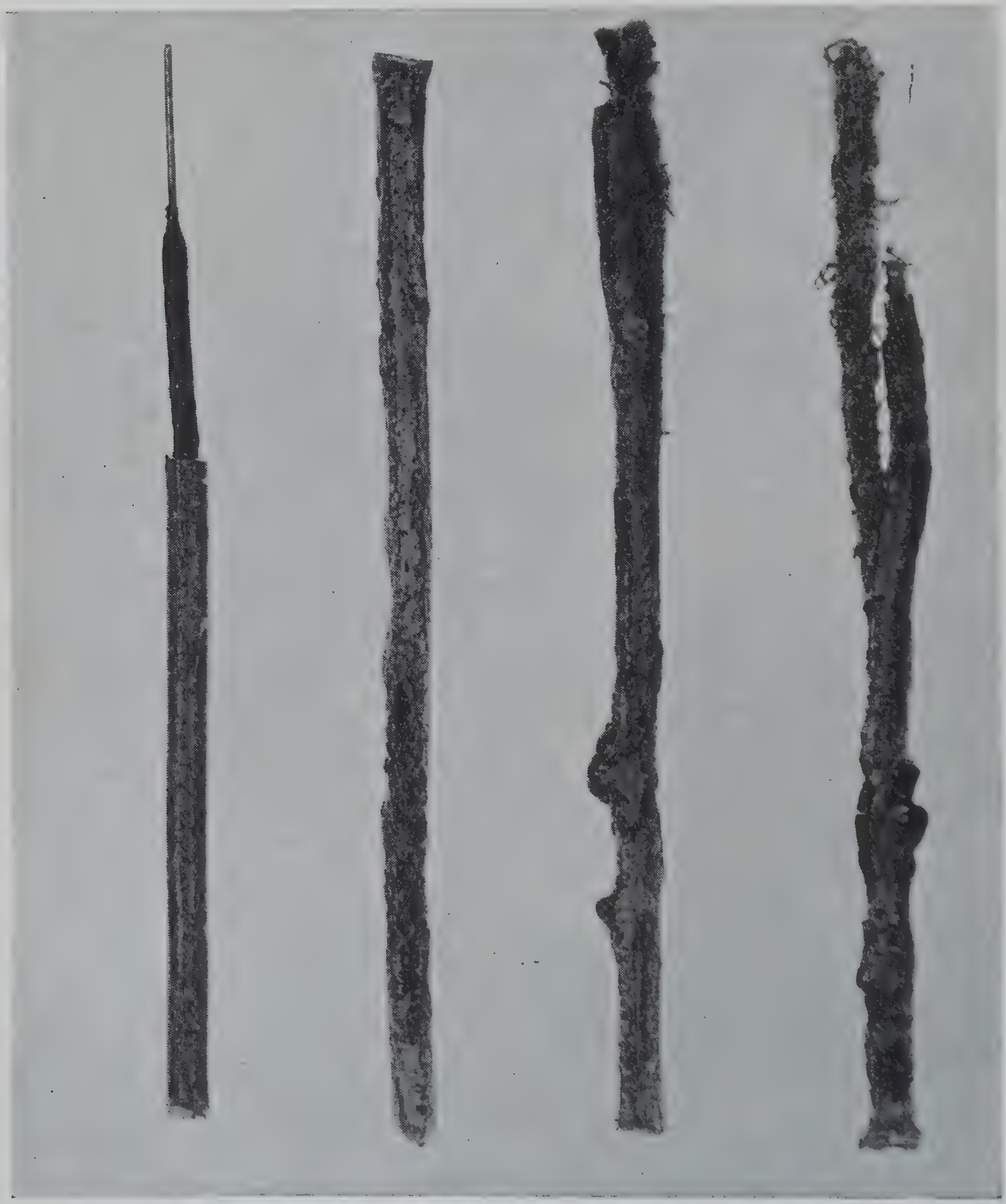

FIGURE 7. EFFECT OF HIGH TEMPERATURE ON LEAD-COVERED SOIL-HEATING CABLE

Left, normal condition of cable. Right, condition after a few hours of use in soil as a pasteurizing device, showing melted lead and injured insulation

A number of unsuccessful attempts have been made to pasteurize with a standard brand of lead-covered soil-heating cable, but this was not suited to withstand the high temperatures needed for this kind of work. What happens to such a cable when used in this way is illustrated in figure 7. In order to avoid melting of the lead sheath, it was necessary to use excessive quantities of the cable per unit volume of soil to obtain the necessary wattage required per cubic foot. The need for a cable that can be used for the dual purpose of soil-heating and -pasteurizing in coldframes, hotbeds, and cutting beds, has often been expressed by both growers and research men.

THE INDUCTION TYPE OF ELECTRIC GRID

One ingenious device for pasteurizing soil in ground beds makes use of the induction principle long employed in certain kinds of electric furnaces and in all transformers. It is essentially a set of iron pipes connected to form a grid somewhat resembling a short wide ladder. A few turns of insulated copper wire are drawn through certain members of the grid, and when alternating current is passed through these coils circulating currents are induced in the iron pipes surrounding them just as in the secondary windings of a transformer. Because of the resistance of the iron pipes, a considerable degree of heat is generated in them.

Two such units have been made by engineers of the Rochester Gas & Electric Corporation, of Rochester, New York; and have been used successfully for a short time in greenhouse soil pasteurization. Since the insulation on the primary wires is subject to high temperatures and a considerable amount of moisture when buried in the soil, it must be carefully selected if durable units are to be obtained. Certain construction difficulties also are met with in assembling this device, but these probably are not insurmountable.

A table giving some of the characteristics of these grid heaters has been prepared by H. A. Brown, of the Rochester Gas & Electric Corporation, and is presented here with Mr. Brown's permission (table 2). The design "A" called for a grid 40 inches long, with eight cross members 6 inches apart and having a heat flux of a little more than 2.5 watts per square inch of pipe surface, the pipe size to be 1 inch. The design "B" was to be 10 feet long, and was to contain only six cross members but with the same heat flux. The heaters were to be used on 115-volt alternating current, and would treat, when buried in the ground, approximately 14 and 30 square feet of bed space, respectively. From the table it is seen that the design chosen for the shorter grid, "A_5", called for 11 turns of no. 12 black waterproofed asbestos-covered copper wire in each of the four loops of the grid, and would have a connected load of 4.2 kilowatts and 41 amperes. The design chosen for the longer grid, "B_6", called for 5 turns of no. 12 wire of the same description in each of the three loops, and would have a load of about 8.4 kilowatts and 79 amperes.

The cost of construction of such grids was rather high, owing to the many threaded elbows. Estimates for materials alone have been placed at approximately $25 for each grid, and the labor is a large item. At present, therefore, further development of the induction type of portable soil pasteurizer does not seem very promising.

TABLE 2. SOME CHARACTERISTICS OF AN INDUCTION HEATING TYPE OF SOIL-PASTEURIZING GRID MADE OF 1-INCH IRON PIPE FOR 60-CYCLE ALTERNATING CURRENT*

Pipe arrangement†	Copper-wire B. & S. gauge	Number of turns	Current in circuit (amperes)	Copper loss (watts)	Iron loss (watts)	Total loss (watts)	Watts per square inch of pipe surface	Voltage on line
A_1......	22	4	40	664	3,208	3,872	2.50	97.1
A_2......	14	10	40	1,236	2,636	3,872	2.50	106.0
A_3......	12	12	40	952	3,872	4,824	3.12	136.0
A_4......	12	12	33.9	684	2,776	3,460	2.23	115.0
A_5‡.....	**12**	**11**	**41.1**	**916**	**3,264**	**4,180**	**2.70**	**115.0**
A_6......	10	11	43.7	656	3,700	4,356	2.81	115.0
A_7......	10	12	37.2	520	3,180	3,700	2.39	115.0
A_8......	14	11	36.4	1,148	2,656	3,804	2.46	115.0
B_1......	6	5	102.8	1,323	8,979	10,302	3.27	115.0
B_2......	6	6	74.8	828	6,507	7,335	2.33	115.0
B_3......	8	5	98.1	1,917	7,896	9,813	3.12	115.0
B_4......	8	6	73.2	1,281	5,976	7,257	2.31	115.0
B_5......	10	5	92.9	2,733	6,834	9,567	3.04	115.0
B_6‡.....	**12**	**5**	**78.7**	**3,120**	**5,256**	**8,376**	**2.66**	**115.0**

*Prepared by H. A. Brown, of the Rochester Gas & Electric Corporation, Rochester, New York.
†Pipe arrangement: A = 4 loops 40 inches long spaced 6 inches connected in series.
B = 3 loops 10 feet long spaced 6 inches connected in series.
‡Design chosen for experimental models.

BURIED ELECTRIC PIPE-TYPE HEATERS

In the interests of safety and economy, buried pipe-type heaters were tested in benches and ground beds as a substitute for vertical plates and the direct-heating methods already tested by some other investigators—as Dix and Rauterberg (1933), Krewatch and Kable (1933), and Fee (1933). With such heaters, many of the objections to the direct method are eliminated at the start. No transformer is necessary. There are no leakage to the ground, no danger to the operator, and no troublesome contact difficulties between electrode and soil. The demand can be accurately determined before starting, and it does not fluctuate from one test run to another.

Tests in greenhouse bench soil

A series of six pipe-type heaters (Hynes & Cox), of ¾-inch galvanized pipe 40 inches long, each heater rated at 400 watts on 230-volt alternating current, was set up in a bench as illustrated in figure 8. The heaters were spaced 7 inches apart, 3½ and 2¼ inches from the top and the bottom of the bench respectively, which empirical setting proved to be satisfactory. By way of comparison with similar heaters already on the market, a set of two General Electric Calrod soil-sterilizing units was placed in another compartment of the bench beside the first. These Calrod heaters had a combined rating of 1500 watts, while that of the six pipe-type Hynes & Cox heaters totaled 2400 watts. Each of the two bench compartments was 5¾ inches deep and contained approximately 5½ cubic feet of soil, thus giving a wattage per cubic foot of 273 and 436, respectively, in the two compartments. The current employed was 230-volt alternating current.

Seven test runs were completed with this equipment, the object being to determine the current consumed by each unit in raising all parts of the soil from room temperature to at least 60° C. Temperatures were measured by a set of 20 thermometers placed carefully and read at regular intervals. Three kinds of soil were employed—sand, loam, and muck. The results are summarized in table 3. It is seen that the efficiency of the two kinds of heaters was not significantly different. The time requirements were in proportion to their current rating, the higher-rating outfit carrying the soil up to a proportionately higher mean temperature in the same number of hours. Sand was the most economically treated of the three kinds of soil.

TABLE 3. Summary of Test Data on Electricity Consumption with Two Kinds of Heaters in Bench Soil of Three Types

Type of soil	Mean temperature rise in three hours (centigrade)		Mean watt-hours per degree rise per cubic foot of soil		Mean kilowatt-hours per 50 degrees rise per cubic foot of soil	
	Hynes & Cox	General Electric	Hynes & Cox	General Electric	Hynes & Cox	General Electric
Sand	59°	40°	22		1.121	
Sand	57°	38°		21		1.068
Loam	52°	39°	27		1.349	
Loam	64°*	39°*		35†		1.759†
Muck	37°	34°	34		1.711	
Muck	51°*	38°*		28		1.417
Muck	37°*	35°*	32		1.612	
Mean	51.0°	37.1	28.8	28.0	1.448	1.411

*Four-hour instead of three-hour periods.
†It is believed that excessive soil moisture may have been responsible for this rather high figure.

A feature of the equipment which was of value in keeping the heat loss down to a minimum, was a 1-inch layer of composition insulating board laid on top of the soil while the heating was in progress (figure 8).

It is thus possible to equip shallow benches with electric heating devices that will adequately and safely pasteurize all kinds of soil on 230-volt current with consumption of approximately 1.5 kilowatt-hours per cubic foot of soil. Considerable variation in the wattage per cubic foot of soil is shown by these tests to be quite permissible if the soil is kept covered. It is admitted, however, that at present the expense of the equipment and the time consumed in handling it do not recommend it as a method of practical value. The equipment for these tests costs approximately $25, and in each case it pasteurized but 5 or 6 cubic feet of soil in three to four hours time.

Some time after the completion of these experiments, a small portable soil sterilizer, employing one 750-watt Calrod unit like the one referred to above, was placed on the market. It is shaped and may be carried like a large suitcase, holds a little more than 2 bushels of soil, operates on 115-volt alternating current, and will pasteurize a charge of soil in four to five hours. The one illustrated in figure 9 has been in use at the entomology greenhouses of Cornell University for several months.

Tests in greenhouse ground beds

To determine the time and the current required to pasteurize soil in a ground bed 10 to 12 inches deep with the above-described portable pipe-type heaters, a set of six, each 40 inches long and of 400-watt rating, was

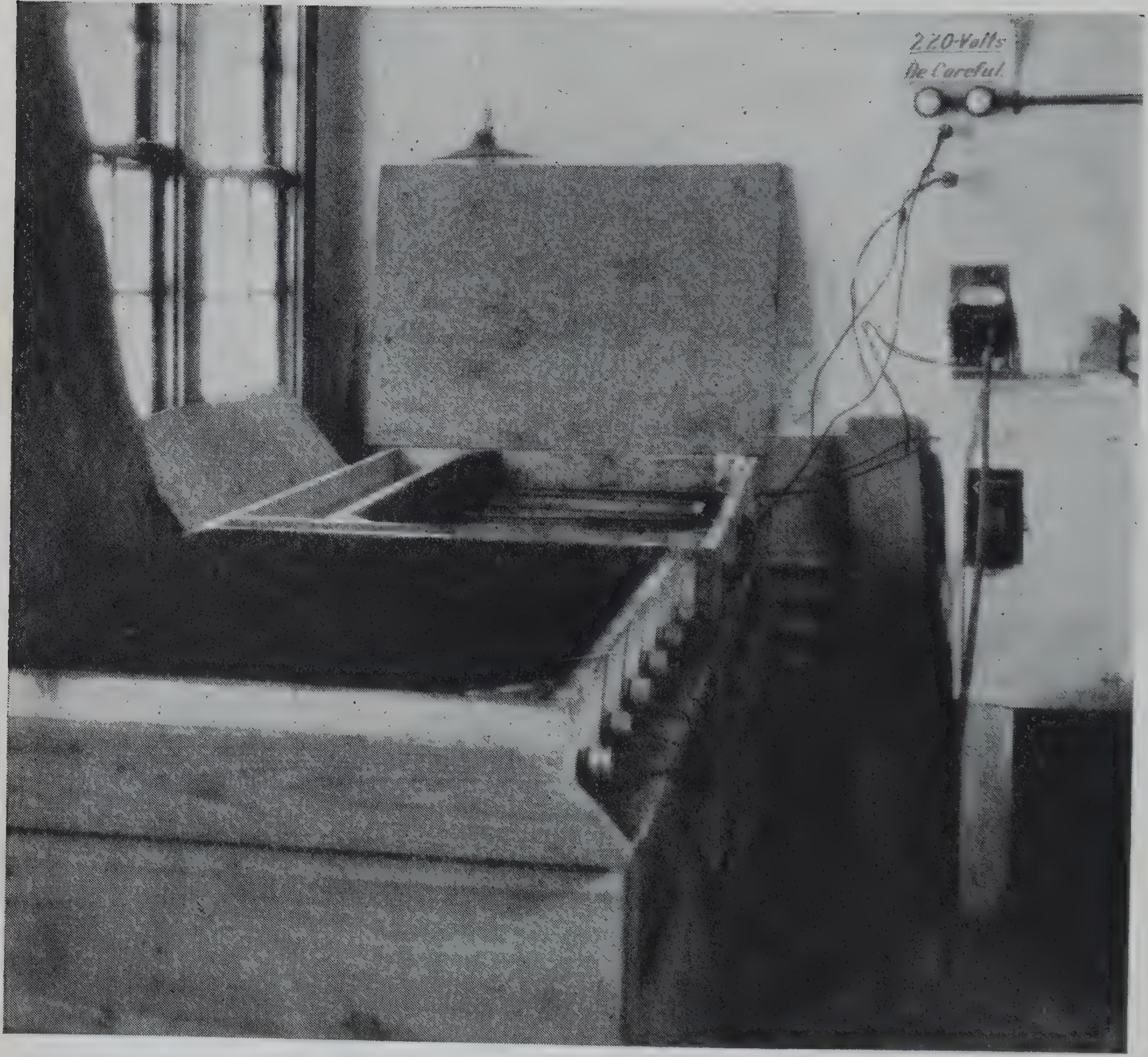

FIGURE 8. A COMPARISON OF TWO KINDS OF SPACE HEATERS IN BENCH SOIL 5¾ INCHES DEEP

The composition insulating board at side and rear is used for covering the soil

buried, the heaters being placed in parallel rows, 7 inches deep and 7 to 8 inches apart. In order to avoid danger of short circuits, watertight right-angled conduit fittings, with short nipples through which the connecting wires could be led above ground, were attached to the ends of each heater (figure 10).

The test plot measured 46 inches wide by 18 feet long, and was heavily infested with *Phytophthora parasitica*. Six changes of position of the heaters, allowing a 3-inch overlap, were sufficient to treat the bed. A period of six to eight hours was required to bring all parts of the soil mass occupied by the heaters up to a minimum pasteurizing temperature to a depth of 11 inches. The total current consumed in thus pasteurizing 10 cubic feet of soil was from 12.2 to nearly 20 kilowatt-hours, depending upon the moisture content of the soil which was purposely altered at times. The results are summarized in table 4. It is seen that as the moisture was increased from 18.8 to 24.7 per cent, the current consumption went up from 26.9 to 44.2 watts per degree rise per cubic foot. Tests made by growing

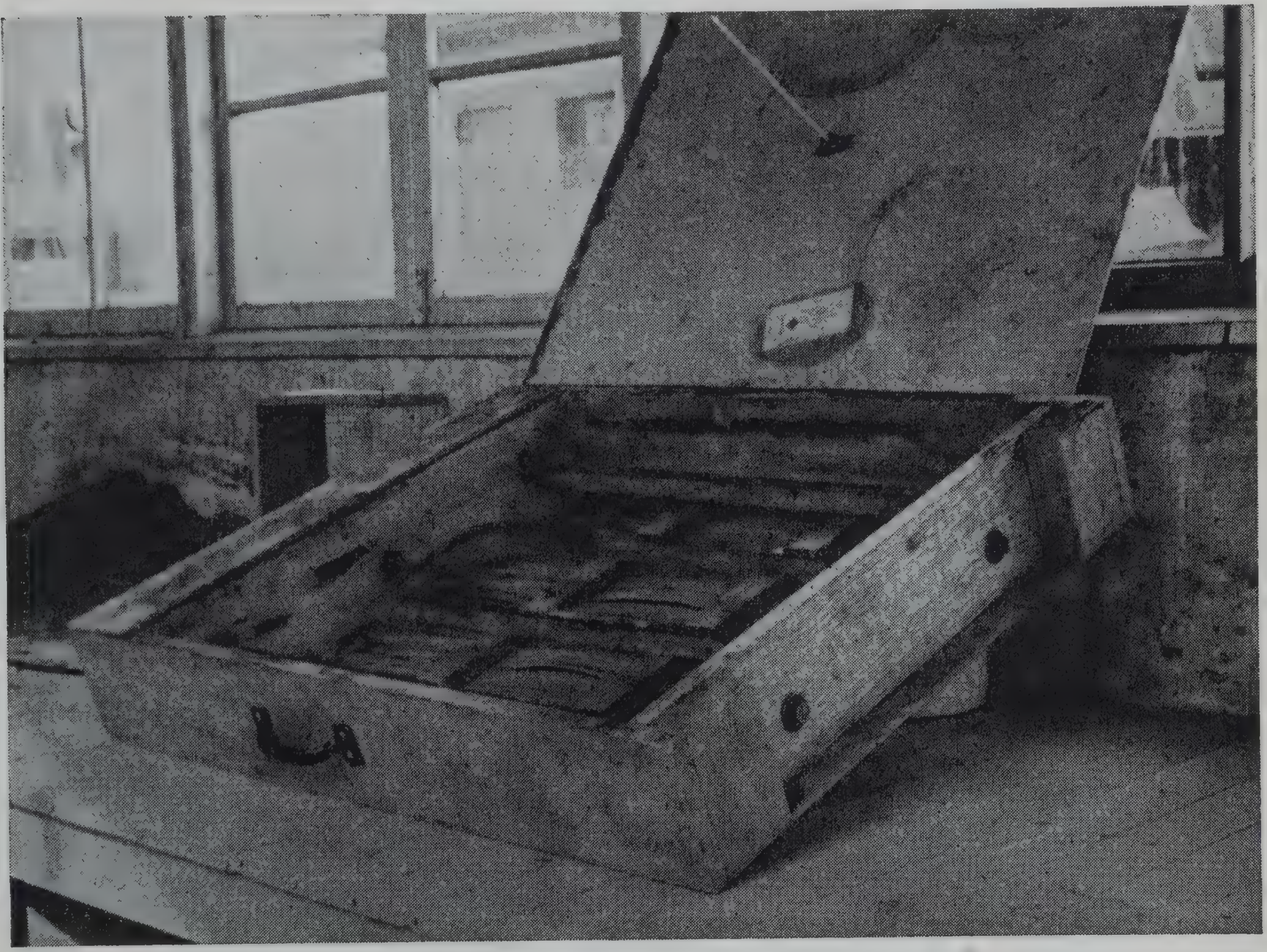

FIGURE 9. A PORTABLE PASTEURIZER FOR 115-VOLT ALTERNATING CURRENT, HOLDING BETWEEN 2 AND 3 BUSHELS OF SOIL. COMPARE WITH FIGURE 8

tobacco plants in treated and in untreated soil indicated that complete control of the Phytophthora disease was obtained by the treatment given to this ground bed.

TABLE 4. SUMMARY OF CURRENT USED IN PASTEURIZING A GROUND BED OF LOAM WITH A SET OF SIX PORTABLE PIPE-TYPE SPACE HEATERS BURIED 7 INCHES DEEP

Test run no.	Mean soil moisture (per cent)	Mean watt-hours per degree rise per cubic foot of soil	Mean kilowatt-hours per 50 degrees rise per cubic foot of soil
6	18.0	26.4	1.320
4	18.8	26.9	1.345
3	19.0	28.3	1.415
5	19.4	31.9	1.599
1	21.0	35.0	1.752
2	24.7	44.2	2.209
Mean	20.28	32.08	1.606

A demonstration of the importance of soil moisture was made by moistening one half of one test plot more than the other half, and noting the difference in mean-temperature readings of the soil in both halves at the end of the seven-hour heating period. On one side the moisture was 18.88 per cent at the start, and on the other side it was 22.05 per cent. At the end of the period the mean-temperature rise of the soil in the drier side was 48.6 degrees centigrade while that of the soil in the wetter side was but

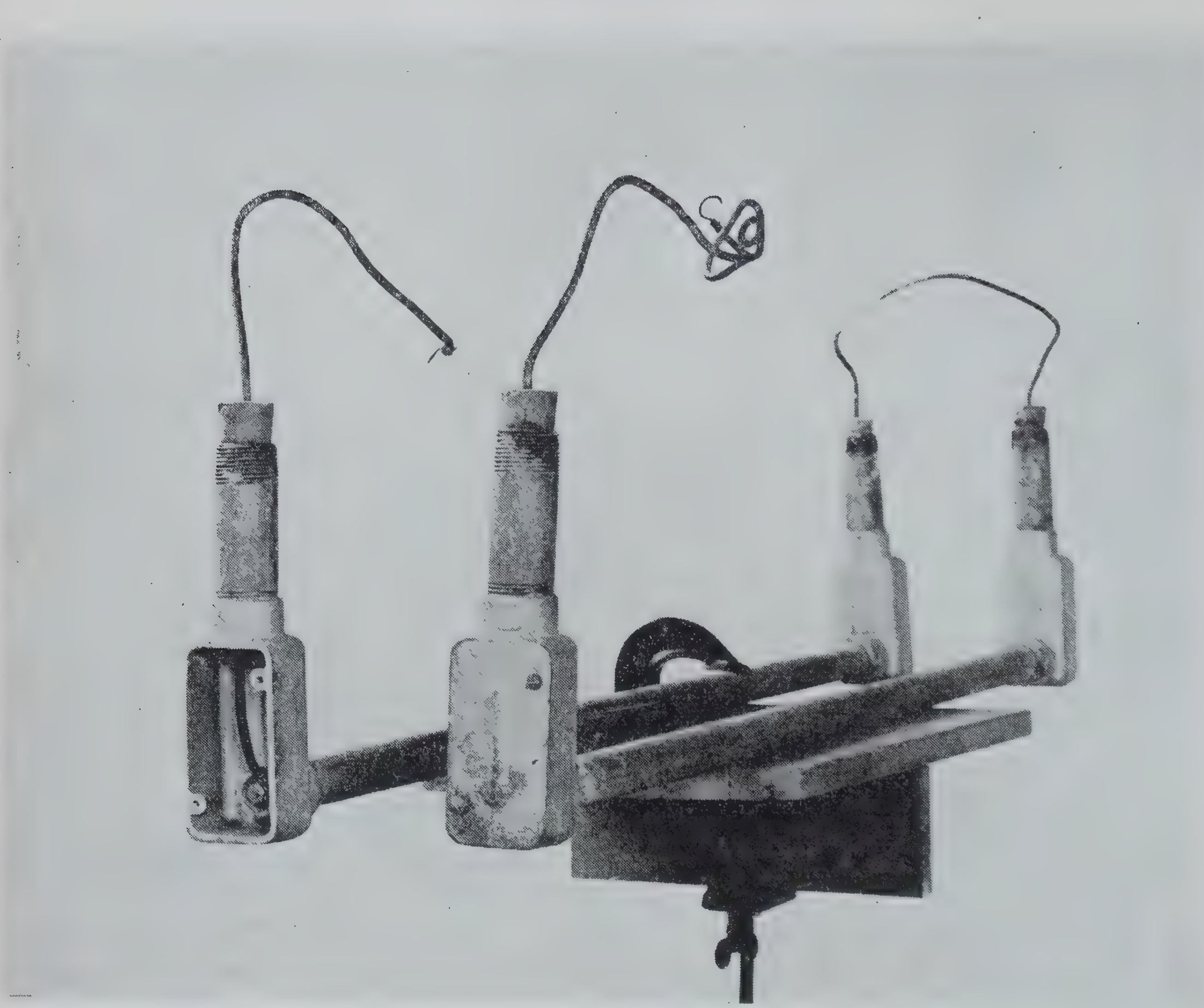

FIGURE 10. A PAIR OF 40-INCH PIPE-TYPE HEATERS, EACH RATING 400 WATTS, SHOWING THE WATERTIGHT CONDUIT FITTINGS AND NIPPLES EMPLOYED ON THE ENDS TO PERMIT SAFE BURIAL AND USE IN MOIST SOIL

42.7 degrees, or 12 per cent lower. In other words, a 14-per-cent-lower initial soil moisture resulted in a 13.8-per-cent-higher mean-temperature rise by the end of the heating period. Similarly, a comparison of test run no. 4 with test run no. 2, in table 4, shows that it required 64 per cent more current to overcome a 31-per-cent difference in initial moisture content of the soil.

TYPES OF ELECTRIC SOIL PASTEURIZERS GENERATING STEAM

Since it appeared that little more could be gained by further experimenting with types of electric heaters that must be buried, dug up, and reset at frequent intervals, attention was turned to the possibility of generating steam with electric heating units close to the soil but not buried in it. That this apparently has not been tried before would seem to be owing to the beliefs (1) that steam must enter the soil under pressure in order to be effective, and (2) that electrical energy is too expensive relatively to other ways of generating steam. Both these ideas evidently need revising.

The author (Newhall, 1930) has reported satisfactory steaming operations, employing the inverted pan, in which good results in eradicating nematodes in ground beds and benches were obtained with steam under less than 12 pounds pressure on the boiler, even when the boiler was 100 feet from the scene of operation. Under such conditions the pressure under the pan itself may be practically nil. Furthermore, on theoretical grounds it is obvious that there is little need for much pressure to drive steam into the soil if one considers the process of heat transfer when the steam enters the soil. In contacting a cold surface, as a particle of soil, the steam is chilled to the point of condensing, and so gives up most of its heat to the soil particle. At the same time its own volume is reduced to a very small fraction of what it was formerly (less than 1/1500). This great reduction in volume enables the steam to pass through the soil, condensing as it passes and releasing its heat, without filling and clogging the open spaces between the soil particles. It therefore takes an almost negligible pressure to drive steam into loose soil which is not already soaking wet.

The importance of having the soil loose, as pointed out by the author (Newhall, 1927), needs no further comment; but the importance of not having it wet can be better understood when one remembers that the specific heat of soil on a weight basis is only from 0.19 to 0.26 that of water, or from 0.44 to 0.57 on a volume basis according to Bouyoucos (1913). A pound of excess water therefore requires 4 or 5 times as many heat units as does a pound of soil, to elevate it to pasteurizing temperatures. Soil should not be too dry (powdery), however, since conduction of heat from one particle to the next can take place better through a thin film of moisture than through a dry air space. With ordinary soil the best results may be expected when the soil barely retains its shape after being squeezed firmly in the hand, rather than crumbling to pieces easily.

The Nixon dairy-utensil sterilizer

The first apparatus tested which employs this principle of steam-heating under atmospheric pressure was designed by M. W. Nixon, of Ithaca, for sterilizing dairy utensils. It has been briefly described by the author (Newhall, 1939, a and b). The steam is generated by a 1500-watt electric hot-plate built into the base of a tight, well-insulated cabinet having one large door in front (figure 11)[8]. The inside measurements in the experimental model employed are; height, 29 inches; width, 28 inches; depth, 15 inches. In the center of the bottom over the hot-plate, and as an integral part of the latter, is a metal pan holding 5 quarts of water which can be brought to a boil in 30 minutes. The device is rated for a 230-volt alternating current. The pan and the heating element are thoroughly insulated with rock wool; and a heat fuse and a time switch are connected in series with the heater, the former to melt in case the water should boil away before the time switch has opened the circuit. Some readers may recognize the similarity between this device and the old Arnold laboratory sterilizer familiar in bacteriology laboratories.

The soil is placed in flats, or trays, piled one above another in the cabinet —which, though having a total capacity of 7 cubic feet, actually holds a net total of only 2½ cubic feet of soil when the soil is in flats 3 inches deep with ¾ inch between the flats. The current is usually left on for nearly two and one-half hours, during which time approximately 3 quarts of water is boiled away and a soil temperature of 60° to 70° C. (140° to 158° F.) is attained. The soil-moisture content is increased by less than 10 per

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[8] Now manufactured by the Victor Dairy Products Company, of Hagerstown, Maryland.

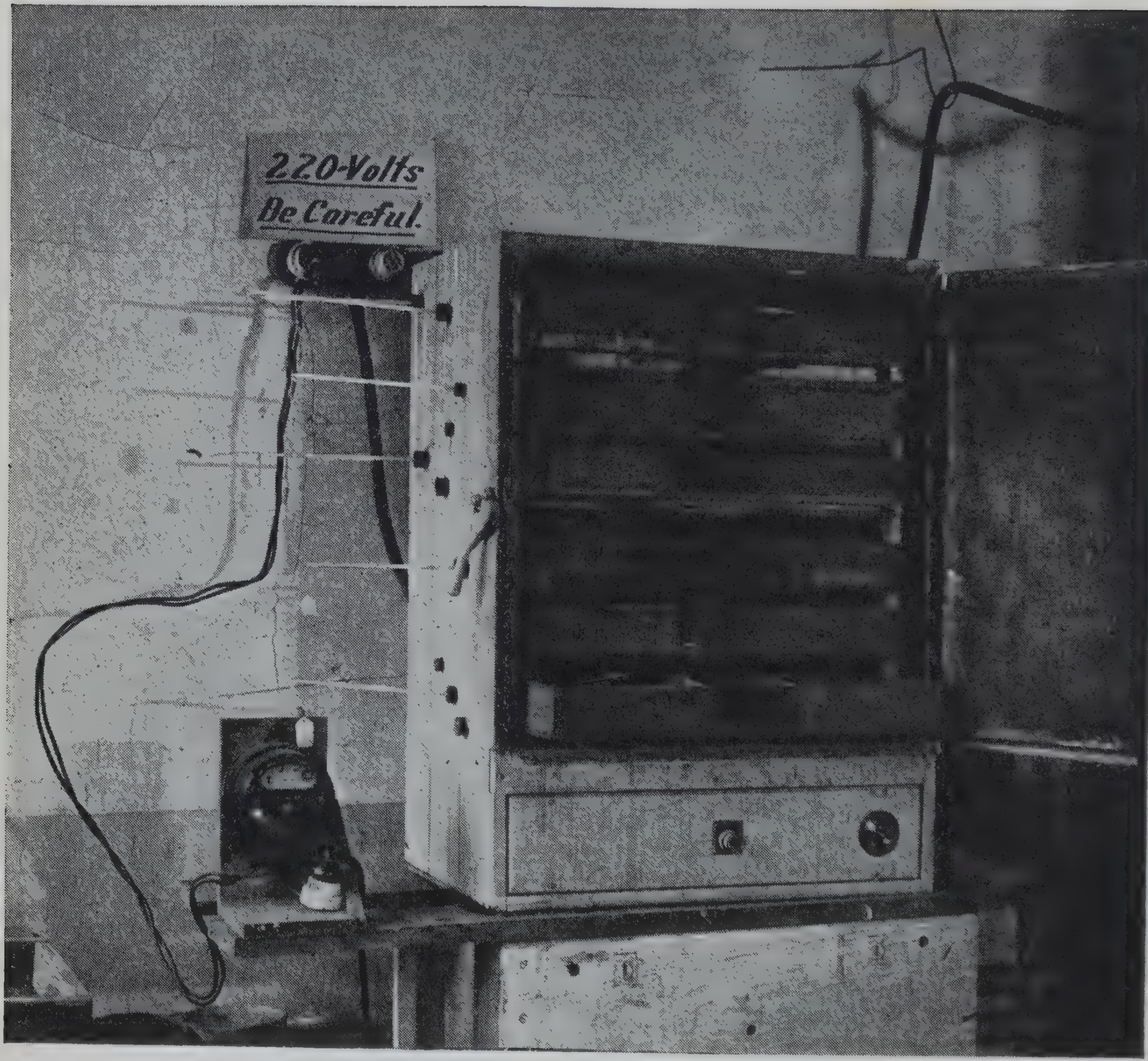

FIGURE 11. THE NIXON ELECTRIC DAIRY-UTENSIL STERILIZER, EXPERIMENTAL MODEL, USED IN MORE THAN 250 TEST RUNS WITH SOIL OF DIFFERENT KINDS, MOISTURE CONTENTS, DEPTHS, AND ARRANGEMENTS

The photograph shows the heat fuse and the time switch in the baseboard

cent, and is practically negligible if the flats are removed while still hot, since they lose much of their moisture while cooling.

In order to determine the conditions under which maximum efficiency could be obtained with this type of pasteurizer, a number of factors were studied in a series of more than 250 test runs[9]. A typical time-temperature curve for a nine-hour period during which the current was on for the first two and one-half hours (figure 12), shows the lag between soil and air temperature, the normal rise in soil temperature of several degrees after the current has been cut off, and the slow cooling reminiscent of the behavior of fireless cookers. As a rule, when the air temperature in the upper corner of the cabinet reached 80° to 85° C., the soil temperature was close to 60° and would advance up to 65° in the next half-hour on the latent heat stored in the heating elements. At the end of this period the soil could be removed, and it could be used as soon as it was cool enough.

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[9] Acknowledgment is made of the valuable assistance given by Herbert Roth in collecting much of the data used here.

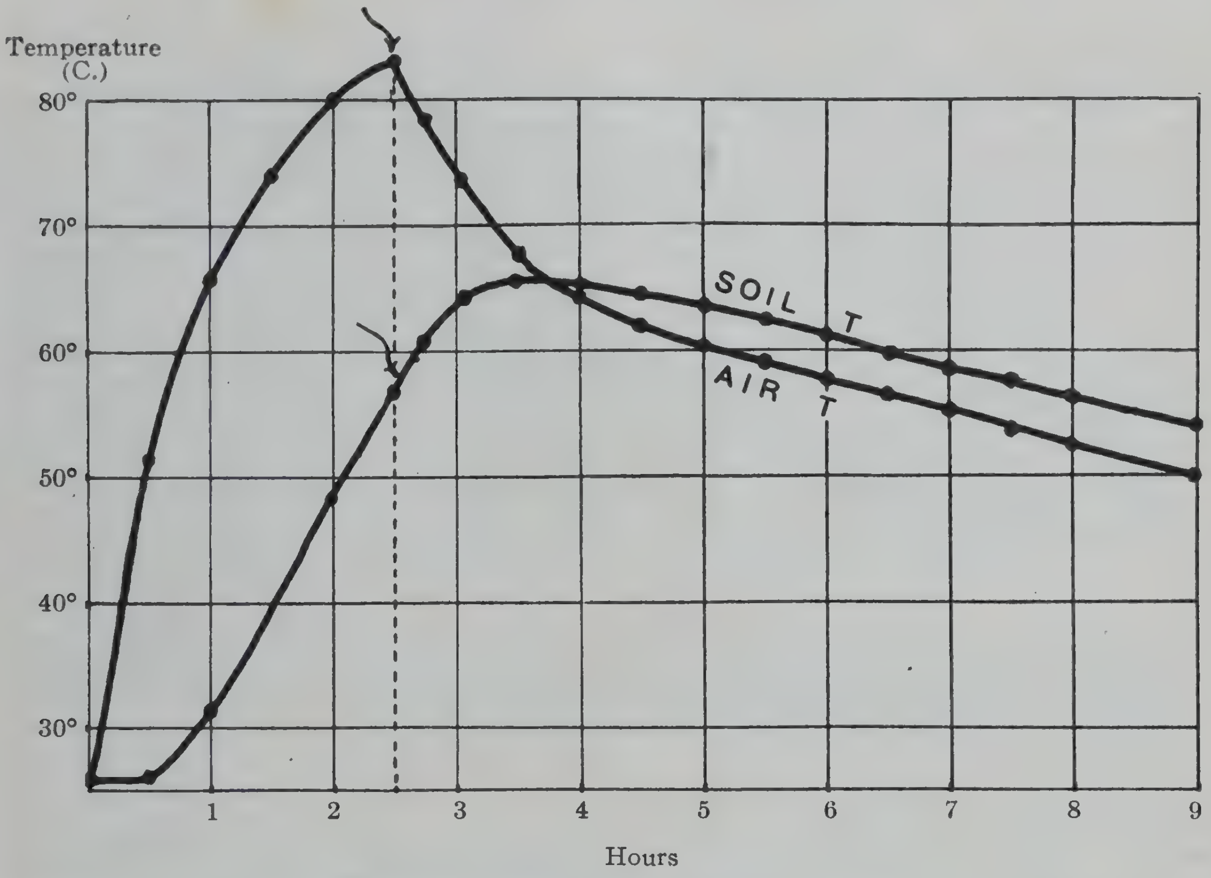


FIGURE 12. A TYPICAL TIME-TEMPERATURE CURVE OBTAINED WITH THE NIXON PASTEURIZER OVER A NINE-HOUR PERIOD WITH THE CURRENT ON FOR THE FIRST TWO AND ONE-HALF HOURS

The relation of the air temperature to the soil temperature, the rise of the soil temperature during the hour following disconnection of the current, and the slow cooling rate of the soil are evident in the graph

The role of initial soil moisture

A comparison of the time-temperature curves of two samples of loam soil, with initial moistures of 9.4 per cent and 21.3 per cent, respectively, will serve to illustrate the importance of soil moisture in determining the current consumed and the time needed to reach a given temperature with loam soil. Such a comparison is shown in figure 13. It required nearly an hour longer to heat the wetter soil up to 65° than to heat the drier soil to that temperature.

Effect of varying the soil depth

The question whether the same volume of soil, in this case 2½ cubic feet, can be heated more economically if spread out in a number of comparatively thin layers rather than in fewer but deeper layers, was answered in the affirmative by tests the results of which are summarized in figure 14. The deeper the flats of soil, the longer is the heating period required to reach any given temperature. For example, soil 3¾ inches deep reached 65° C. in one and three-quarter hours of heating, while soil 5½ inches deep reached only 54°, and soil 9½ inches deep reached only 43°, in the same length of time. Muck soil, with its higher moisture content, was particularly affected by this depth factor.

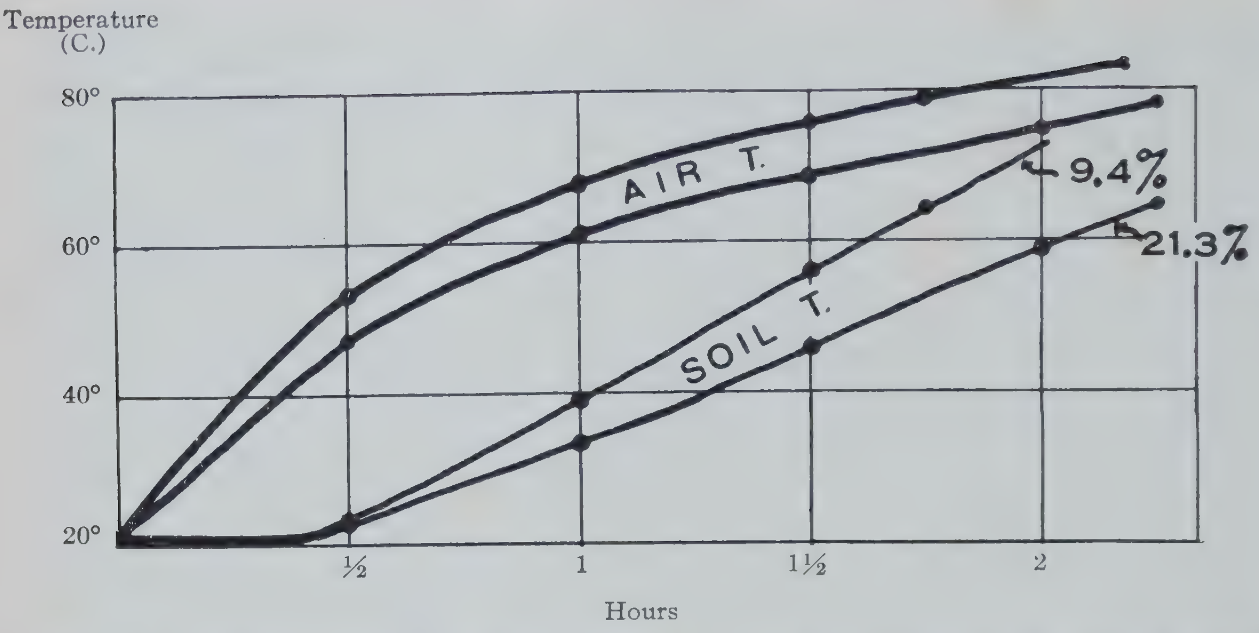


FIGURE 13. EFFECT OF TWO DIFFERENT INITIAL SOIL MOISTURES ON THE TIME REQUIRED TO ELEVATE SOIL TO 65° C. IN THE NIXON PASTEURIZER, AND ON THE RELATIONS OF THE AIR TEMPERATURE IN THE CABINET TO THE SOIL TEMPERATURE

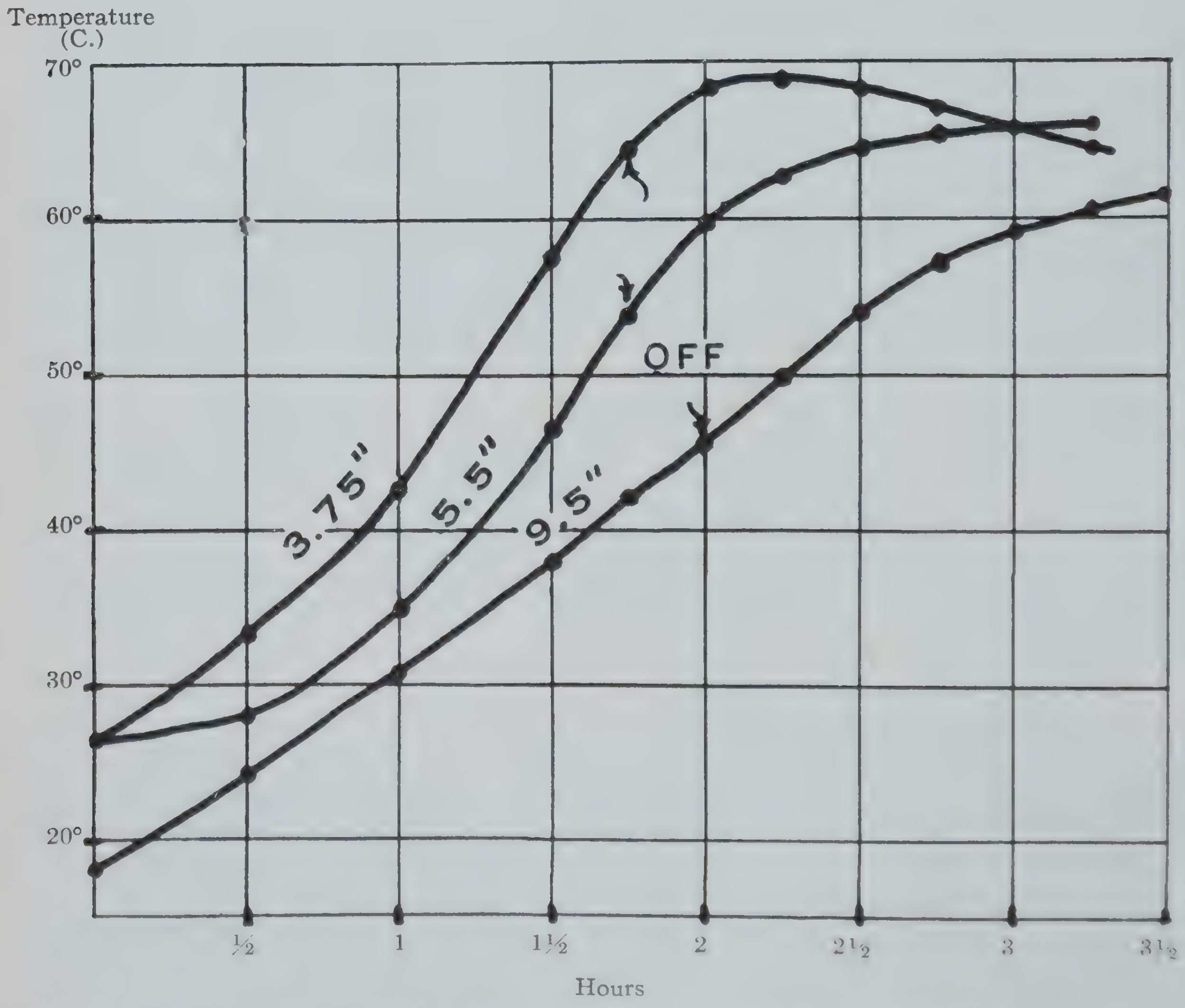


FIGURE 14. EFFECT OF THREE DIFFERENT SOIL DEPTHS ON THE TIME REQUIRED TO RAISE THE TEMPERATURE OF 2½ CUBIC FEET OF LOAM SOIL TO 65° C. IN THE NIXON PASTEURIZER

The current was on during the first one and three-quarters to two hours

Effect of varying the soil volume

Another factor that has a bearing on the general efficiency of the pasteurizer in question, is the ratio of soil volume to size of the heating element. No attempt was made to try different-sized heating elements; but by varying the volume of the soil and keeping records of the current consumed per cubic foot of soil per 50° C. rise in temperature, there was found to be a relation between volume and current consumption, indicating that greater efficiency was obtained when the cabinet was filled to capacity (2½ cubic feet) than when it was only half filled. The latent heat-absorbing capacity of the heater itself has a bearing on this. The time required to attain a given temperature was almost directly proportional to the volume of soil being heated. Both these relationships are summarized in figure 15. There is some indication from this that the 1500-watt heater employed could be used in a cabinet of still larger size than this one.

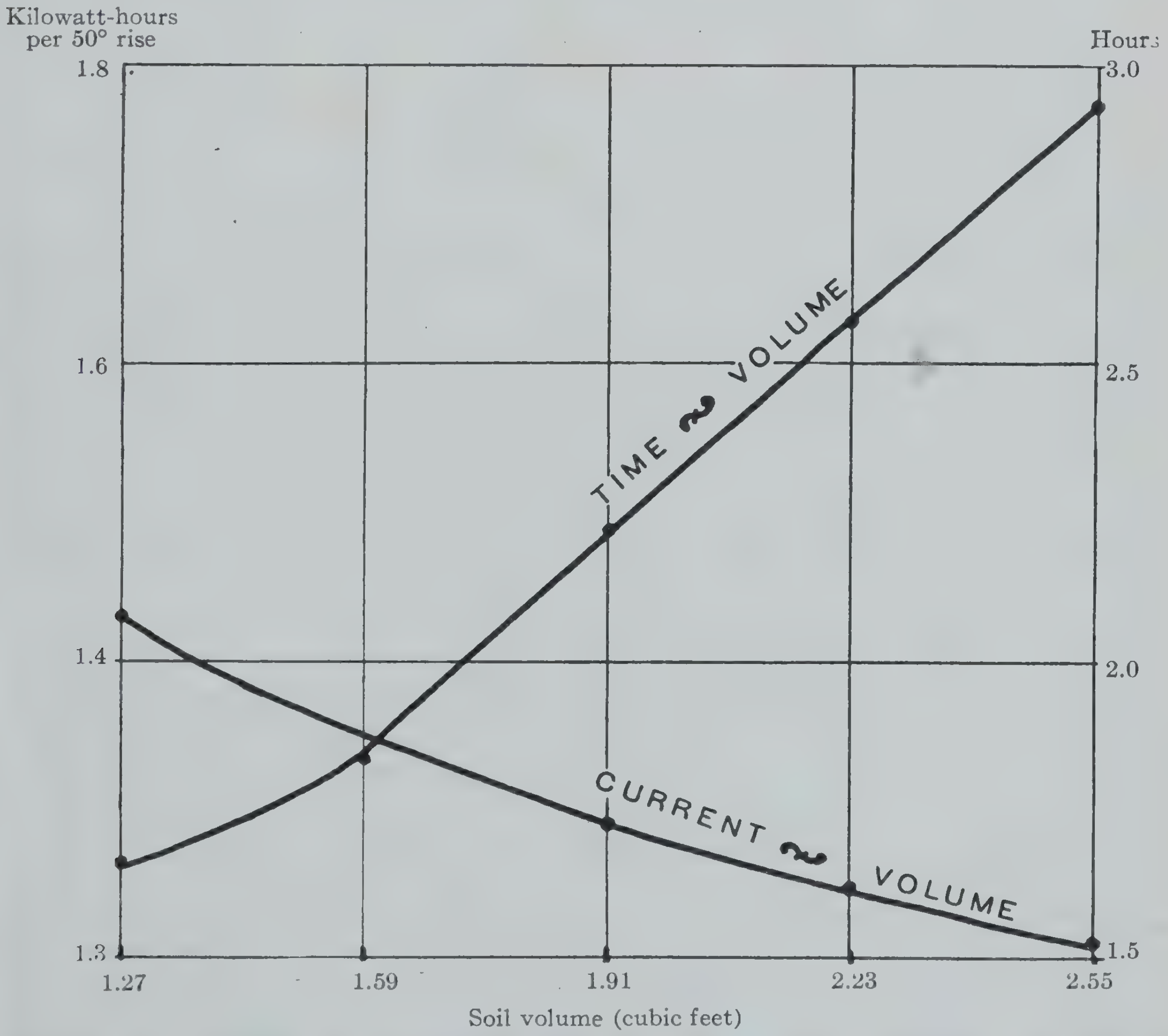


FIGURE 15. EFFECT OF INCREASING THE VOLUME OF SOIL TREATED, ON THE TIME REQUIRED FOR THE SOIL TO REACH 65° C. AND ON THE CURRENT REQUIRED PER CUBIC FOOT OF SOIL

Effect of other miscellaneous factors

Mention has already been made of the latent, or stored, heat in the heaters that could be relied on to raise the soil temperature another 5 to 8 degrees in less than an hour after the current has been turned off. It must be obvious from this, that the greatest efficiency is attained by continuous operation, one charge of soil following another.

A study of efficiency in relation to a loose as compared with a compact condition of the soil in the trays, revealed little difference in the case of sand but a measurable difference with muck. By packing the muck in the trays a considerably larger amount could be put in, which increased the load by just that much.

Arrangement of the flats in the cabinet with respect to clearance around the edges and between them, was of importance in permitting easy access and free circulation of the steam. A clearance of 1 inch all around is believed to be the most satisfactory. Leaving an open space resembling a chimney up through the center was of little benefit. Greater efficiency was obtained when that space was filled with soil.

Alternate periods of heating, in which the current was turned on for 10 minutes at a time and off for 10 minutes, only seemed to increase the time required for the soil to reach 65° C., without decreasing the current consumption.

The temperature of the water at the start was of less importance than might be supposed at first thought. Very little was gained in efficiency by starting with hot water (82° C.) as against water at room temperature. The reason is apparent from a consideration of the following facts. The heat required to raise 1 pound of water through 1 degree Fahrenheit is, by definition, 1 B.T.U. In 3½ quarts there are 7.3 pounds, so that 1036 B.T.U. are required to raise that amount of water from room temperature (21° C.) to the boiling point (100° C.). But to convert 7.3 pounds of water to steam after it has reached the boiling point requires another 970.4 B.T.U.×7.3, or 7084 B.T.U. From this it is evident that heating the water up to the boiling point takes only about one-seventh of the total energy consumed in the entire operation. Incidentally, this also shows why a pound of water converted into steam is so much more effective than a pound of boiling hot water, in treating soils.

Mean current consumed per cubic foot of soil

Summarizing 150 of the test runs made with the Nixon pasteurizer, the current required to raise 1 cubic foot of soil to a temperature of 65° C. from an original temperature of 15° was found to lie between 1.15 and 1.68 kilowatt-hours for sand (mean 1.34, or 27 watts per degree), between 1.16 and 1.62 kilowatt-hours for loam (mean 1.39, or 28 watts per degree), and between 1.54 and 2.05 kilowatt-hours for muck, with its higher moisture content (mean 1.78, or 35 watts per degree). The variations observed between tests of any one kind of soil are due largely to variable soil-moisture content, soil depth, degree of soil compactness, and initial temperature of the heater. There is no significant difference in requirements between sand and loam, but the greater current consumption of muck as compared with the other two kinds of soil is highly significant statistically and is believed to be due to the greater proportion of water in the muck.

Some considerations relative to specifications for a larger model

In considering the construction of a larger pasteurizer capable of treating twenty-five flats at a time instead of six, a question arises as to how tall such a pasteurizer could safely be built without sacrificing efficiency.

While no tests were run, the impression was gained that disappointing results might be obtained if the pasteurizer were much more than 3 or 4 feet high, as there might be too great a difference in temperature between the top and the bottom flat at any given time. These variations were usually of only a few minutes duration in the cabinet under test, but, as they sometimes amounted to 10 or 15 degrees centigrade, they suggest that it might be better to enlarge in a horizontal rather than in a vertical plane.

A larger cabinet, capable of holding twenty-five flats 12 by 24 by 3½ inches in size, or nearly 15 cubic feet of soil (net), would require six 1500-watt heaters with a connected load of 9 kilowatts on 230 volts, or approximately 50 amperes. This is based on a rating of 600 watts per cubic foot of soil. To allow for circulation and space to be taken by the flats themselves would require a volume close to 45 cubic feet, which could be supplied by a cabinet with inside dimensions as follows: height, 30 inches; width, 7 feet 8 inches; depth, 28 inches. A lower wattage rating per cubic foot may be adequate.

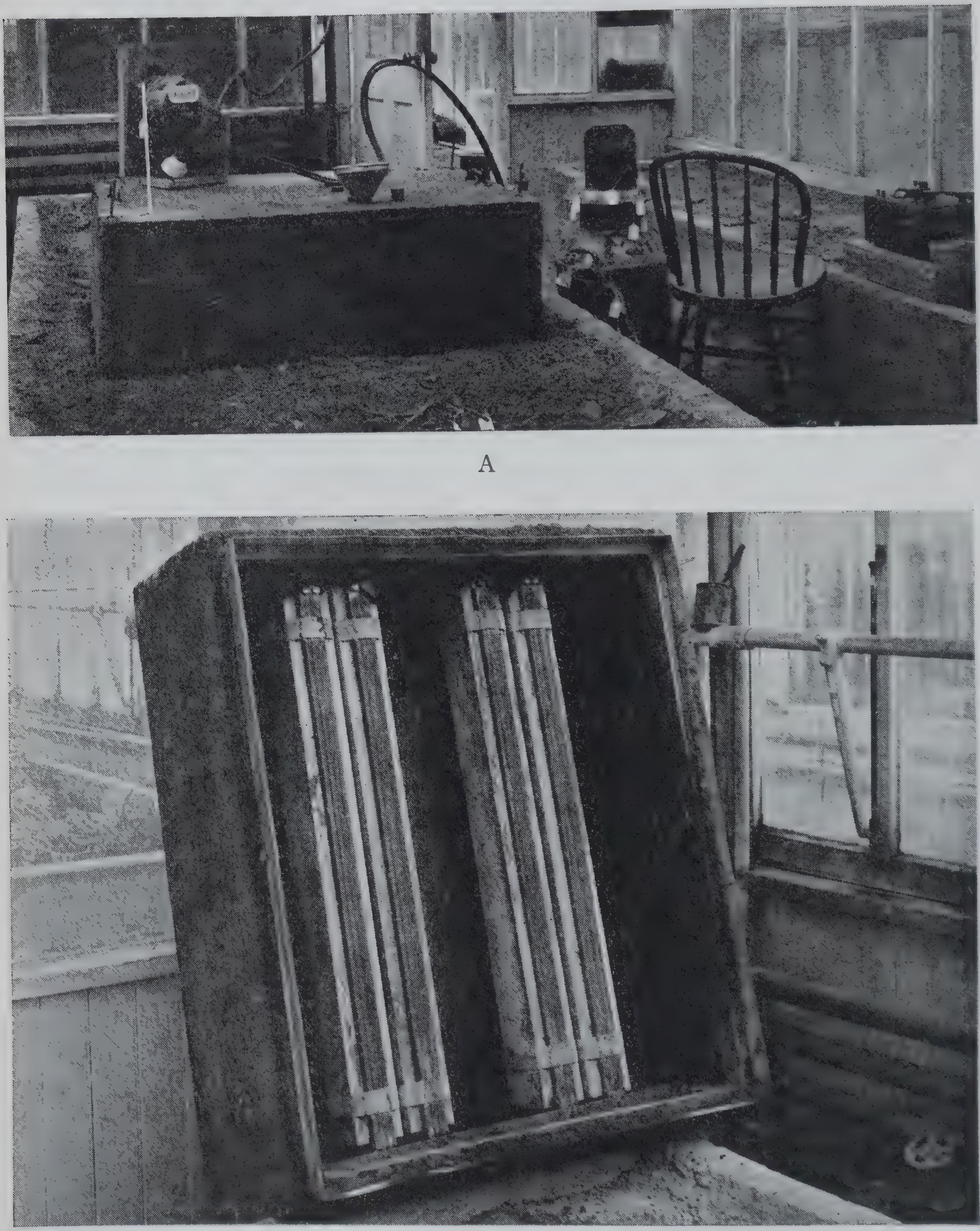
The Cornell electric inverted steam pan

The success obtained with the Nixon dairy-utensil sterilizer as a soil pasteurizer prompted the construction of a portable device, briefly described by the author in an earlier publication (Newhall, 1939 b), for use on greenhouse benches, ground beds, coldframes, hotbeds, and cutting beds. This is essentially an inverted pan similar to those long in use by greenhouse growers. But instead of steam being piped to it from a distant boiler, a 230-volt alternating current is brought to the pan and the steam is generated beneath in troughs of water heated by strap heaters (figure 16).

The experimental model was made of 1-inch insulating board over a light wooden frame. Its dimensions were 2½ feet wide by 3 feet long by 1 foot high. A 2-inch strip of galvanized iron around the lower edges helped to seal the edges when the pan was pushed down on the soil. The four metal water reservoirs inside held approximately 5 quarts of water each, and they were filled through stoppered holes in the top. The four 1500-watt heaters were wired in parallel; so that a constant demand of 6 kilowatts was employed to steam 7½ square feet of soil, which was accomplished to a depth of approximately 10 inches in two to three hours.

Tests were made in ground beds of loam soil with moisture contents ranging from 11 to 15 per cent. To facilitate accurate measurement and to gain a more complete picture of the rise in temperature of the soil at different depths and locations beneath the pan, thermocouples of copper constantan were buried at 3-, 6-, 9-, and 12-inch depths. One set was placed 3 inches in from one corner, another near the middle of one side, and a third under the center of the pan. The soil was loosened with a spading fork before the pan was placed over it. A graphic presentation of the temperatures obtained at the different levels is shown in figure 17.

It took 20 minutes to start the water boiling. The soil temperature began rising at the 3-inch depth 10 or 20 minutes later. In 60 minutes it began to rise at the 6-inch depth, and in 90 minutes at the 9-inch depth. The current was turned off in two hours, at which time the temperature was rising at the 12-inch depth. At the lower levels the temperature continued to rise for some time at a rate similar to the rate of fall in the



A

B

FIGURE 16. THE CORNELL ELECTRIC INVERTED STEAM PAN

A, In use on a raised ground bed
B, Tipped on end, showing the arrangement of the four 1500-watt strap heaters beneath the water reservoirs. (See figure 19)

upper layers. Maximum temperatures at the lower depths in the corner were 20 degrees centigrade lower than those under the center of the pan. The water continued to boil for about 15 minutes after the current was turned off, and, as the pan was not moved, there was undoubtedly a con-

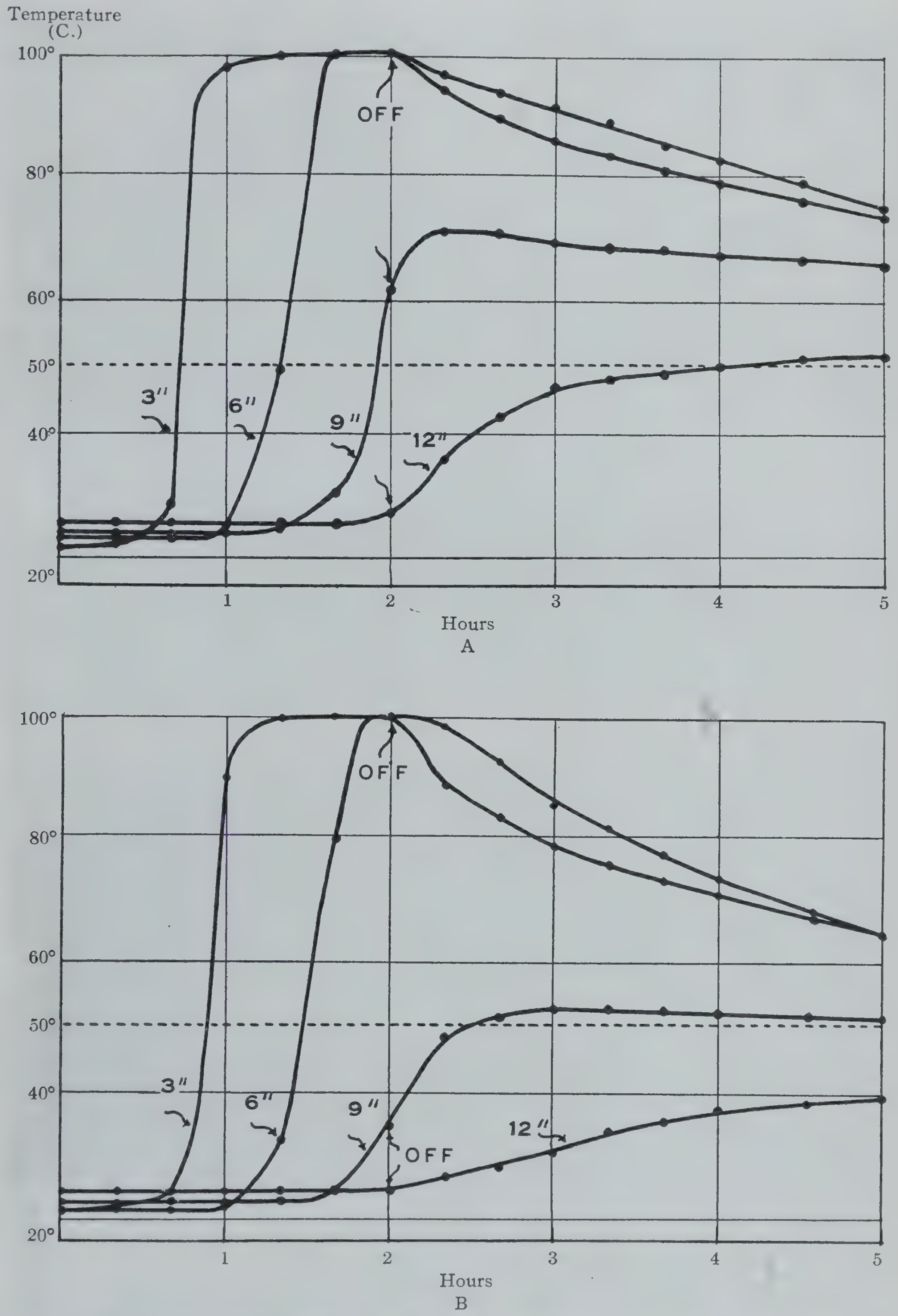


FIGURE 17. SOIL TEMPERATURES ATTAINED IN A GROUND BED OF LOAM AT 3-, 6-, 9-, AND 12-INCH DEPTHS BENEATH THE CORNELL ELECTRIC INVERTED STEAM PAN DURING A TYPICAL TEST RUN

A, Temperatures at points under the center of the pan
B, Temperatures at points 3 inches in from one corner
The current was on during the first two hours

siderable amount of stored heat given off from the heaters during the next three hours. In practice the best results were obtained by laying a piece of 1-inch composition insulating board on the freshly steamed soil to conserve the heat, and by continuous use of the outfit, which called for shifting it to a new position every two hours, never permitting the heaters to cool off.

The current consumed in treating 7½ square feet of soil was metered at 11 kilowatt-hours, or 1.47 kilowatt-hours per square foot. Assuming pasteurization to a 10-inch depth means 1.76 kilowatt-hours per cubic foot of soil, which is similar in efficiency to that with other methods already described.

A test run on loam made with three of the four 1500-watt heaters produced the results shown in figure 18. It is evident from this figure that

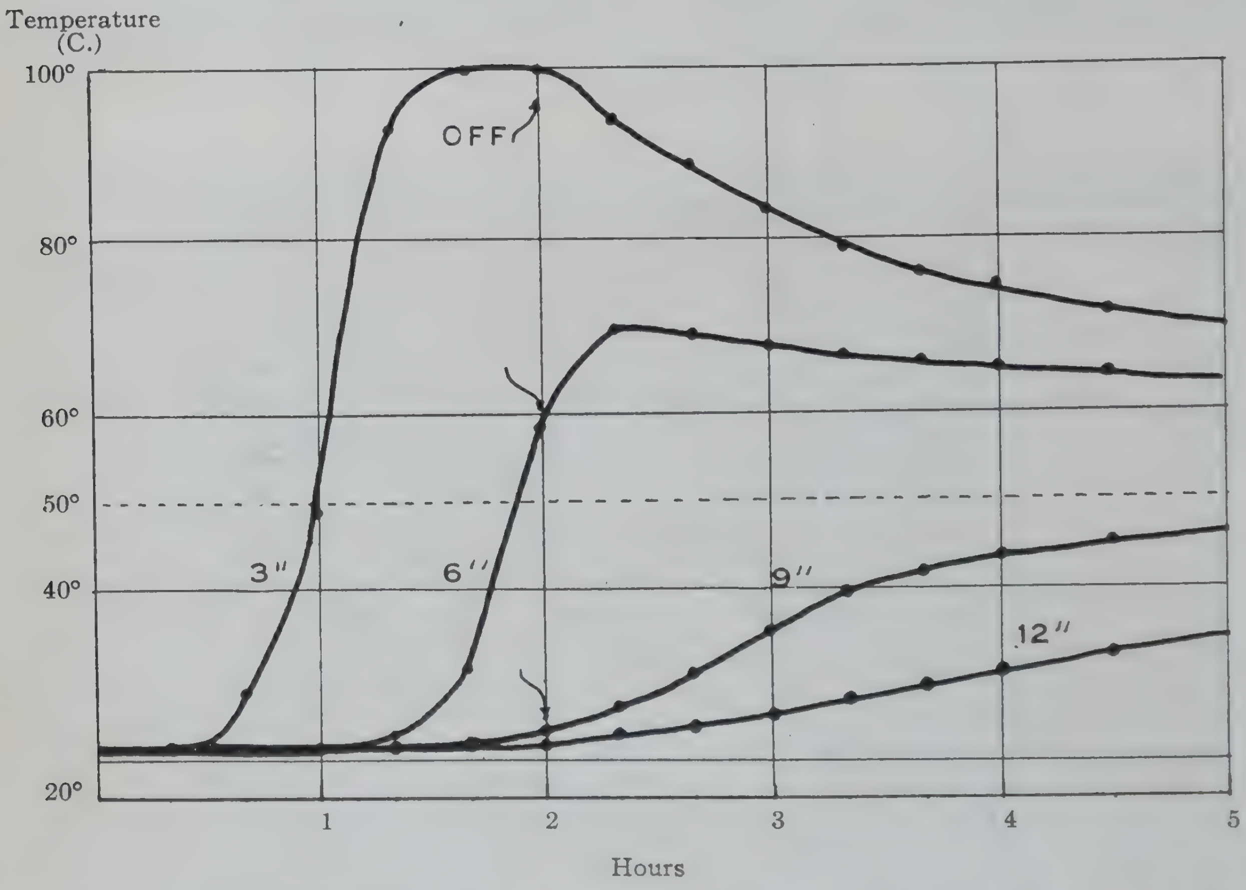


FIGURE 18. SOIL TEMPERATURES ATTAINED IN LOAM AT 3-, 6-, 9-, AND 12-INCH DEPTHS BENEATH THE CORNELL ELECTRIC INVERTED STEAM PAN WHEN OPERATING ON THREE OF THE FOUR 1500-WATT HEATERS

(To be compared with figure 17, A)

pasteurizing temperatures could not be expected much below the 6-inch level without increasing the time of operation beyond two hours. This could be done, however, as there was always some water left in the reservoirs at the end of the two-hour heating period.

From these tests it was deduced that the four heaters used would be adequate for a pan of 25 or 30 per cent larger area, or approximately 10 square feet, without increasing the required heating period too much. Accordingly such a pan was built of asbestos board and angle iron by the Joseph Harris Seed Company, and was put into operation on that company's slat-house soil out-of-doors in the spring of 1939 (figure 19).

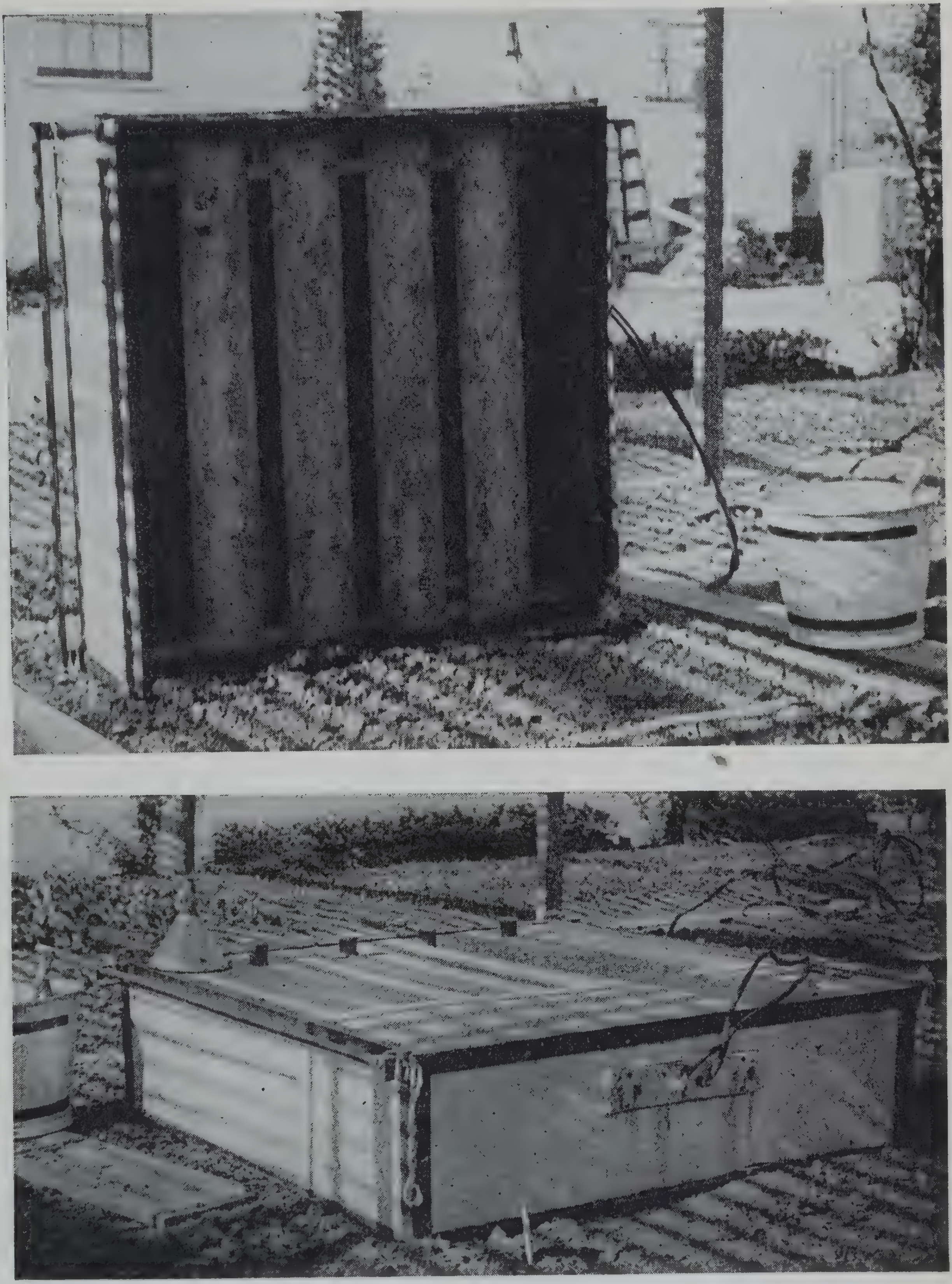


Figure 19. MODEL OF AN ELECTRIC SOIL PASTEURIZER BUILT OF ASBESTOS BOARD AND ANGLE IRON, COVERING 10 SQUARE FEET OF SOIL

This pasteurizer, used outdoors on slat-house soil of the Joseph Harris Seed Company at Coldwater, New York, is heated by four 1500-watt strap heaters. The upper photograph shows the strips of asbestos board which shield the soil from direct radiation

Periods of operation of 45 minutes were sufficient to reduce the number of weeds (chiefly grass) from nearly 500 per square yard to less than 12, which amply paid for the current consumed. Such treatment also seemed to eliminate all damping-off of delphinium, which is very subject to this trouble. Temperatures up to 65° C. were attained 4 or 5 inches below the surface of the soil.

Limitations, advantages, and suggested improvements

At this point it is easy to see that limitations as to the area which can be steamed with electrical energy are imposed by the limited size of the service lines at most men's disposal. To provide for an area of 150 square feet at a time, which is not large in commercial operations employing steam, would require a battery of sixty 1500-watt heaters, which would demand 90 kilowatts, or more than 400 amperes. This load would require a transformer, conduits, and heavy cable, and would increase considerably the difficulties and hazards in manipulating the apparatus. All electrical methods for the average grower are definitely limited to comparatively small operations where large areas do not have to be treated in a few days' time.

One advantage possessed by the electric inverted pan is the fact that the surface of the soil is left in a comparatively dry condition, owing to the radiant heat given off by the strap heaters just above the soil. For some situations this is an improvement over methods which may leave the soil in a puddled condition. However, there was evidence that this too can be overdone to the point of overheating the surface soil. In order to avoid such overheating, strips of Transite,[10] 4 inches wide and ½ inch thick, were mounted immediately beneath the strap heaters. These reduced the direct radiation from the heaters to the surface of the soil.

Longer life could be built into this pan by giving the inside a heavy water-proof coating to prevent the insulating board from absorbing moisture. The pan could be made more rigid by lining or covering it with sheet metal, or by using angle iron on the edges; but care must be taken to guard against short circuits and current leakage in the highly saturated atmosphere within the device. It would be desirable to have some means of determining how much water remained in the reservoirs at any time. Also, a spirit level could well be made a part of the regular equipment.

The Hutchings continuous electric soil pasteurizer

In the spring of 1939 the author was invited to collaborate in designing and testing an ingenious soil pasteurizer made by Donald Hutchings, of the Joseph Harris Seed Company at Coldwater, New York. The device, illustrated in figure 20, is unique in its resemblance to modern electric baking ovens of the continuous type or to some types of flash pasteurizing equipment. The soil, which is dumped into a hopper at one end, begins coming out at the other end in 5 minutes, at a temperature of 65° to 80° C. Its passage through the pasteurizer is regulated so that the organic matter is not overheated and yet a sufficient temperature is attained to kill pathogenic organisms and nearly all weed seeds. A few seeds of legumes survive. The soil is propelled through the pasteurizer by a specially constructed continuous chain operated by a ⅓-hp electric motor. The speed is controlled by a motor on a reducing gear and a set of pulleys of varying sizes. The chain picks up the soil under the hopper and drags it horizontally in small piles, ½ inch deep, across a stainless-steel table 6 inches

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[10] A Johns-Manville product containing asbestos.

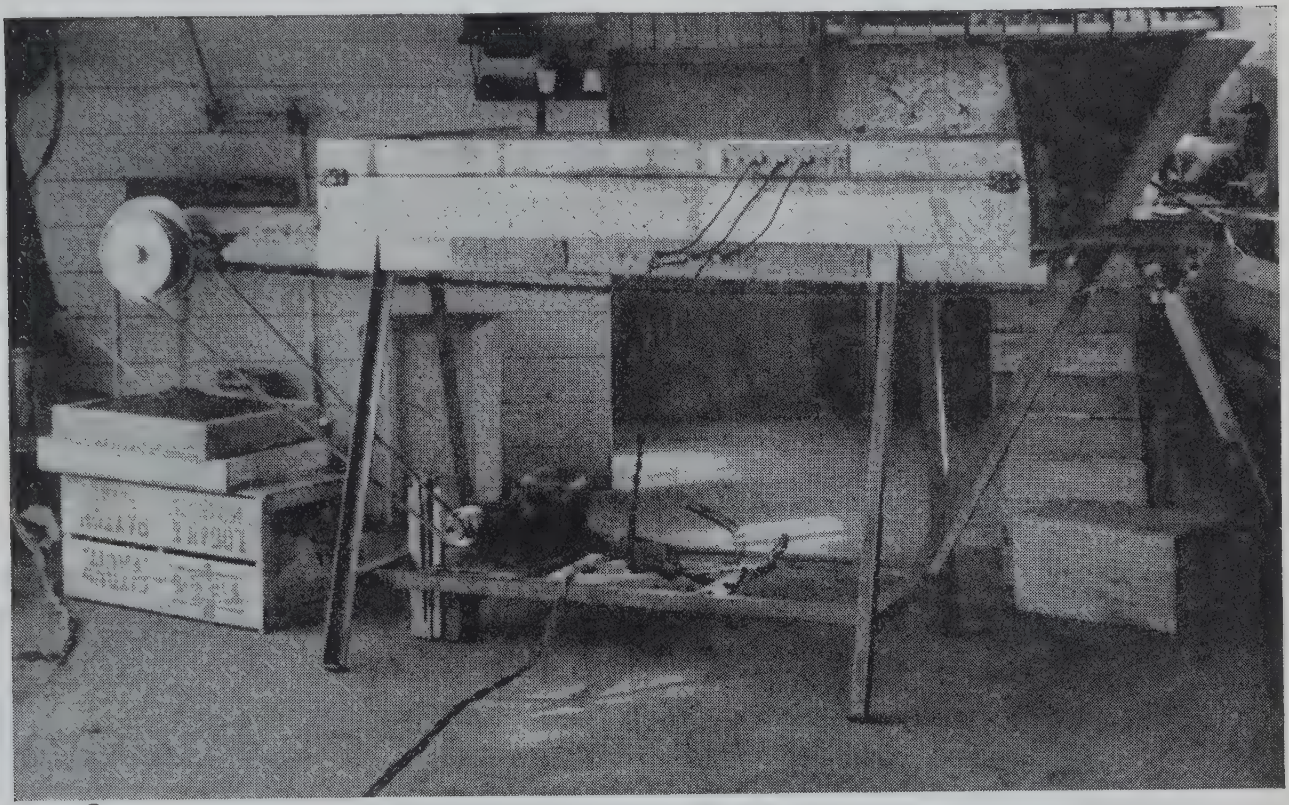

Figure 20. THE HUTCHINGS CONTINUOUS ELECTRIC SOIL PASTEURIZER, IN USE AT COLDWATER, NEW YORK

This device draws 10 kilowatts and pasteurizes 6.6 cubic feet of soil per hour

wide by 64 inches long. This table is heated from below by a number of strap heaters with a total effective wattage of 5.340 kilowatt-hours. Additional heat is directed downward on the moving soil by a set of six 1000-watt "sunbowl" heaters mounted just above and having a total effective wattage, on 205 volts, of 4.625 kilowatt-hours. All of this mechanism is fully enclosed and insulated against heat losses to the outside air. Approximately 15 minutes is required to create a sufficient temperature within the box. After that, 18 to 20 flats of soil can be put through each hour, or 6.6 cubic feet, which means that 1 cubic foot is treated with approximately 1.5 kilowatt-hours after pre-heating of the device, or about 0.5 kilowatt-hour per flat.

As the soil drops into empty flats which are then left overnight in piles, it retains much of its heat for some time and probably exercises some pasteurizing effect on the flats themselves. The temperature of the soil after standing for an hour in the center of one of these piles of flats, was still 50° C.

In testing the device, flats of previously prepared loam known to be infested with damping-off organisms and adjusted to various moisture contents were put through the pasteurizer. Each flat was then planted with 150 seeds of cucumber, which is very subject to damping-off. Nearly perfect stands were obtained in all of the treated flats, while the stands in the two untreated flats averaged only 74 per cent. The temperatures, moisture contents, and stands of cucumbers and weeds in this test are summarized in table 5.

The driest sample of soil (8 per cent) was too dry, since it came out of the pasteurizer in a slightly dusty condition. The wettest sample (56 per

TABLE 5. RESULTS OF TESTS OF THE HUTCHINGS CONTINUOUS ELECTRIC SOIL PASTEURIZER, MARCH 1939

	Original soil moisture (per cent)	Original soil temperature (C.)	Final highest soil temperature attained (C.)	Stand of cucumbers (per cent)	Number of weeds per flat
Untreated soil:					
Check 1	10	20°	20°	68	20
Check 2	10	20°	20°	80	25
Treated soil:					
Dry 1	8	3°	68°	98	0
Medium dry 2	16	5°	69°	99	0
Medium moist 3	23	7°	76°	100	0
Wet 4	56	4°	75°	100	0

cent), on the other hand, was too moist, because it tended to pack between the cross members of the chain which propelled it. Excess moisture has been found to cause some soils to ball up in an unsatisfactory manner. Although vapor can be seen passing off as the soil drops from the end of the pasteurizer, there is very little evident change in total moisture content during the entire process because of the short time that has elapsed, the comparatively low maximum temperatures reached, and the covering of each flat by its successor.

Whether this rapid pasteurizing of soil will prove adequate to control all soil-inhabiting pathogens and all weed seeds remains to be seen. But to obtain higher soil temperatures or longer heating periods simply requires different-sized pulleys to slow up the passage of the soil a little. One important factor in the success of this device may be the prompt piling of treated flats so that the heated soil may cool slowly, like a fireless cooker, for several hours. This practice will probably control even the most difficult organisms. A good many hundreds of flats of soil have been put through this machine during the past two seasons, with very satisfactory results.

Needless to say, the soil must be free from all stones, sticks, or other solid objects which could clog the mechanism, permit overheating, and cause unnecessary delays. It is necessary to employ heaters that will stand the high temperatures resulting from their confinement, and to use plenty of good thermal insulation to avoid heat losses.

DISCUSSION

In the testing of several different types of electric soil-pasteurizing devices, the author has had in mind the ever-increasing demand for a dependable, economical, and safe means of ridding the soil of its parasitic microorganisms, weed seeds, and insect pests. The use of electricity in heating soils is advantageous for several reasons. One is that heat is universally effective against practically all the pests commonly found in soil. Another is that electricity is becoming more available at rates that are increasingly inviting. Still another is that in many places where the climate is too mild to warrant steam-heating equipment, electricity is a logical substitute as a source of power for heat.

Cabinet types of electric pasteurizers have been in use for eight years and have proved successful for potting soil, flats, and benches where some extra handling of the soil was not particularly objectionable. But the problem of economically treating soil in ground beds, coldframes, hotbeds, and cutting beds without having to cart the soil to and from the pasteurizer, has never been satisfactorily solved for the man who has no available source of steam. While the tests reported herein show that it is possible to use buried pipe-type electric heaters for this purpose, the labor and expense involved will probably hinder the adoption of this method.

The development of the Nixon electric dairy-utensil sterilizer paved the way for successful application of the same principle to a portable inverted steam pan operated by electricity. It is felt that in developing this device some progress has been made toward solving the question of a method of pasteurizing soil in place without having to move it, where only electricity as a source of heat is available. At present the process is not rapid enough to recommend the adoption of the method where large areas must be treated quickly. For example, it took 14 hours to treat 125 square feet of cutting bench with a pan covering 7½ square feet at a time and drawing nearly 6 kilowatts. Although the cost of $1.25 for current (2 cents per kilowatt-hour, or 1 cent per square foot) was low enough, the time consumed was too long to justify recommending the method for large areas. Increasing the size of the pan to hasten the work puts heavy demands on the service line and increases the hazard, so that at present the device is adapted to comparatively small operations. However, the ease with which it pasteurizes loam to a depth of 8 or 10 inches with the expenditure of only 1.5 kilowatt-hours per square foot, and a cost for construction as low as that of most other pasteurizing equipment of like capacity,[11] recommend this pasteurizer for trial not only in greenhouses but also on coldframes, hotbeds, and cutting benches, on outdoor slat-house soil, or wherever an ordinary inverted steam pan could be used. The size employed in these experiments drew slightly less than 30 amperes on a 230-volt alternating-current supply line.

For the firm or the individual employing a considerable amount of soil for seedling flats or pots every day, a pasteurizer of a continuous semi-flash type, which will heat enough soil in a few hours for the next day's needs without changing the moisture content appreciably, may prove useful in regions where electric rates are comparatively low. The Hutchings continuous electric soil pasteurizer built on these lines has been in successful operation for two seasons with an expenditure approximating 1.5 kilowatt-hours per cubic foot, or less than 1 cent per flat. Reduction in the cost of weeding is said to offset this expense. An advantage pertaining to both the Nixon and the Hutchings device, particularly the Hutchings, is their ability to kill plant pathogens without subjecting the soil to a long sterilizing period at unnecessarily high temperatures. It is believed that low-temperature pasteurization and speed are both of importance, especially where soils that are rich in nutrients and high in lime are being heated. Such soils are very likely to be temporarily injured by overheating, which results in poor germination and poor seedling growth.

Injury from overheating rich soils seems to be due in general to the increase in soluble salts, particularly to an increase in nitrates and ammonium salts brought about by reduction of the organic nitrogen as shown by Lyon and Bizzell (1910), Johnson (1919), and other investigators. Not all soils are equally affected, but composts are perhaps the most readily injured. Some plants, such as lettuce, sweet peas, snapdragons, spinach, and tomatoes, are more sentitive to these adverse changes than are others. Plants of the grass family, the cucurbits, and other deep-rooted plants are more resistant. The changes are temporary and are somewhat proportional to the richness (organic content) of the soil as well as to the length of the heating period and the temperature used. After a few weeks of retarded growth, plants in overheated soils usually experience a period of stimulated growth.

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[11] The chief item of expense was $20 for the four heaters themselves, while other items brought the total cost of materials to approximately $28.

Injury from overheating soil can often be remedied by prompt leaching with hot or cold water in amounts up to 3 or 4 gallons to a square foot of soil. Such soil is also benefited by simply postponing its use for 10 to 20 days to permit the resumption of bacterial and fungal activity, or by liberal applications of superphosphate or of organic matter such as chopped straw. Herzog (1939) has recently stated that fungal activity during a 42-day period following soil sterilization is much greater in acid soils (pH 4.7) than in alkaline soils (pH 7.6).

Lawrence (1938) recommends the treatment of loam soil for composts, and of manure or leaf mold, separately, and mixing them afterward. This is especially advised if the compost is not to be used for several months. Loams high in lime are more likely to suffer injury than are acid soils, and lime should not be added to a soil before pasteurizing. If these simple rules are adhered to, the most satisfactory results should be obtained in the growing of seedlings and other plants in soils from which all pathogenic organisms have been eliminated by pasteurization.

SUMMARY

From a consideration of the thermal death-points of more than 120 plant-pathogenic microorganisms, coupled with practical soil tests, the conclusion is reached that a final soil temperature of 65° C. (150° F.) is sufficiently high to ensure pasteurization against all important plant pathogens as well as most weed seeds.

Electrical means of pasteurizing soils divide themselves into two general methods, the direct-heating and the indirect-heating. Since the advantages with respect to safety lie principally with the indirect-heating method, a number of attempts were made to extend the usefulness of this method, which involved the testing of different kinds of equipment.

Experiments with ordinary soil-heating cable showed this to be unable to withstand the temperature required of it in soil-pasteurization work.

An induction type of electric pipe grid was employed more or less successfully for a short time by one of the electric power companies; this is described on page 13.

Soil in greenhouse benches and ground beds was brought up to pasteurizing temperatures with a series of buried portable pipe-type heaters, of ¾-inch galvanized pipe, having a rating of approximately 100 watts per linear foot and spaced to give 220 to 400 watts per cubic foot of soil.

Successful use was made of the new Nixon electric dairy-utensil steamer for pasteurization of soil in flats, or trays. The characteristics of this device were studied in a series of more than 250 test runs, in which it was shown that pasteurizing temperatures could be obtained in two to three hours at an expenditure of approximately 1.37 kilowatt-hours per cubic foot of soil treated. No appreciable pressure of the steam generated is necessary for adequate soil treatment.

A portable, electrically operated, inverted steam pan was tested. With this device, pasteurizing temperatures in bench and ground-bed soil were obtained to a depth of 7 to 10 inches in two hours with the expenditure of approximately 1.5 kilowatt-hours per square foot of soil. The device appears to have promise as a means of treating coldframe, hotbed, cutting-bench, seedbed, and slat-house soil while in place.

A continuous or semi-flash type of electric soil pasteurizer was tested, in which the soil is placed in a hopper at one end and discharged 5 minutes later from the other end, having attained a temperature of 65° to 80° C. on its way through at an expenditure of 1.5 kilowatt-hours per cubic foot of soil treated.

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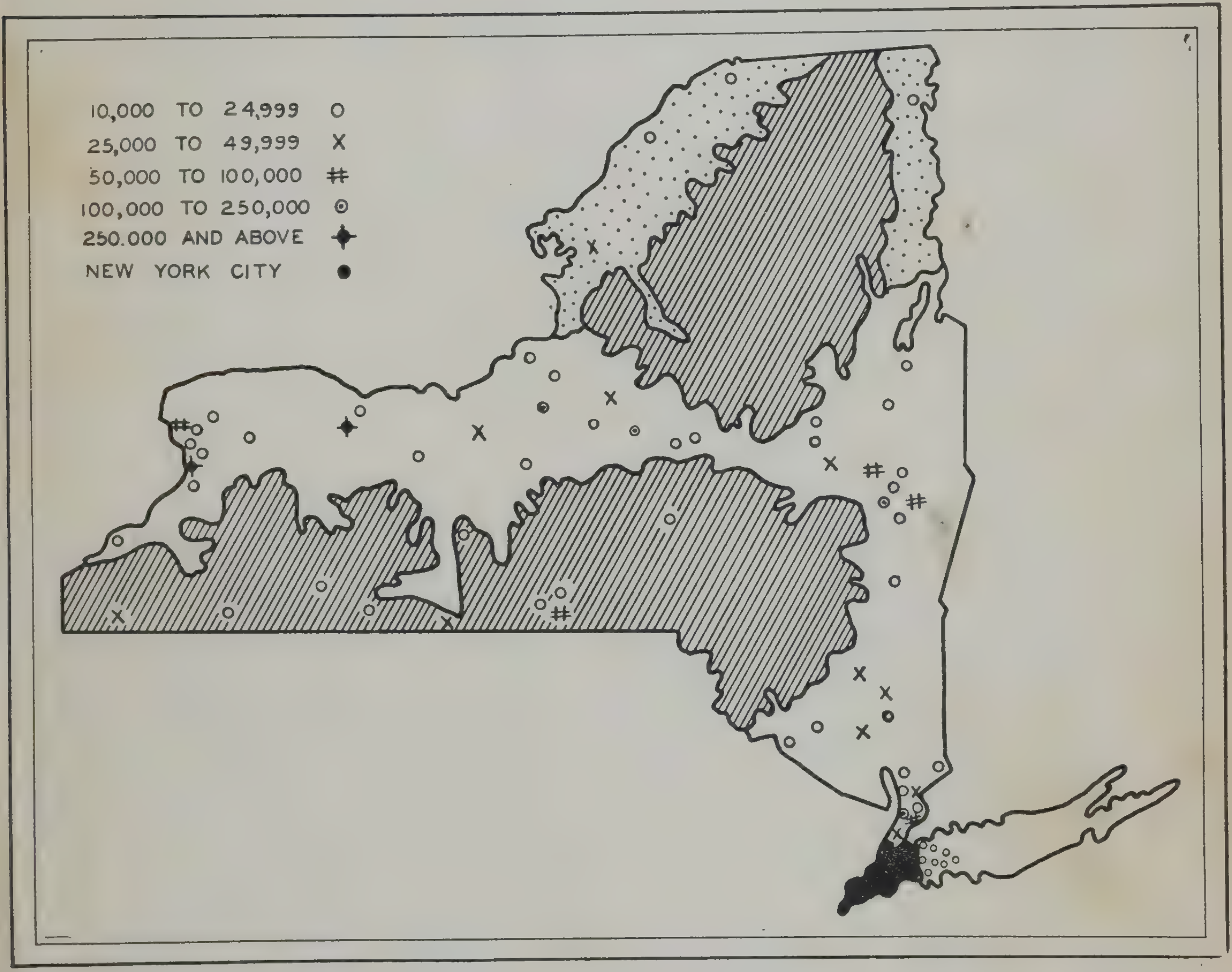
Bulletin 733

May 1940

Natural Increase in the Population of New York State

W. A. Anderson



CHIEF TOPOGRAPHICAL AREAS OF THE STATE AND LOCATION OF CITIES OF 10,000 OR MORE POPULATION

Population losses are being replaced naturally in excess in the Northern Mountain and Valley Areas and the Southern Tier Area, while in the Great L Valley and the New York City region population losses are not being replaced

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NATURAL INCREASE IN THE POPULATION OF NEW YORK STATE

W. A. ANDERSON

This Station has previously published two studies concerning recent changes in the New York State population. The first described the changes which took place in the number and proportions of the classes of the population that lived in various civil divisions between 1910 and 1930.[1] The second treated the net cumulative movement of population to the State from foreign countries and the net cumulative movement to the State from other States.[2]

The present bulletin describes the natural increase in this population. Population changes as a result of net migration, resulting from movement to and from an area; it is also affected by natural change, resulting from the difference between the number of births and deaths in the area. To indicate the influences of population upon social organization, it is important to analyze the trends in the natural increase and to point out the types of population that are reproduced in the area. This also helps to understand probable migration in the area. Such changes have important relations to institutional organization and activity.

THE INDEX OF NATURAL INCREASE

The natural increase in the New York State population is measured in this study through the use of an index. Population experts have devised a method for measuring the natural increase of any population by use of a maintenance ratio of increase related to the actual ratio of children less than 5 years of age to the actual number of women 20 to 44 years of age.

The "Index of Natural Increase" used in this study is the number of children less than 5 years of age per 1000 women 20 to 44 years of age, divided by a replacement ratio. The replacement ratio is the number of children less than 5 years of age per 1000 women aged 20 to 44 in the stationary population which would result from the continual operation of the current mortality rates and in the absence of any migration.[3]

Lorimer and Osborn[3] define the index of natural increase in a similar way. They say "the ratio of the number of births or number of children found in any group under specified conditions to the corresponding replacement ratio gives a reproduction index, or estimated rate of reproduction per generation."

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[1] Population trends in New York State, 1900 to 1930. By W. A. Anderson. Cornell Univ. Agr. Exp. Sta. Bul. 547. 1932.

[2] Movement of population to and from New York State. By W. A. Anderson. Cornell Univ. Agr. Exp. Sta. Bul. 591. 1934.

[3] The number of women 20 to 44 years of age in the urban, rural, and rural non-farm population by counties is not available in the published volumes of the United States Census. The number of women aged 20 to 44 years in the total rural, the farm, and the rural non-farm population was furnished from special tabulations of census data by the Division of Farm Population and Rural Welfare of the Bureau of Agricultural Economics, United States Department of Agriculture, and the Division of Social Research of the Works Progress Administration. The number in the urban population was obtained by subtracting the number in the total rural population from the number in the total population. The data upon which the indexes were computed are included in the series of 5 appendix tables.

The definition of the replacement ratio was furnished by Dr. Harold Dorn, Statistician, United States Health Service.

Lorimer and Osborn. Dynamics of population, p. 399. 1934.

An index of 100 means that there are just enough children 0 to 4 years old to each 1000 women 20 to 44 years of age to replace the persons removed by death in a generation of 28 years. An index of 125 would mean that at the end of the generation of 28 years the area would have one-fourth more population than at the beginning, assuming either no migration in or out of the area or equal migration. An index of 75 would mean a decrease of 25 per cent under the same assumptions. Where the number of children less than 5 years of age and the number of women 20 to 44 years of age in a population are available, the use of such an index makes it possible to show what elements in the population are naturally reproduced.

REPLACEMENT RATIOS

The Scripps Foundation for Research in Population Problems, utilizing life tables available, has computed replacement ratios, as of 1930, of 442 for the total population of New York State, 443, for the urban, and 439 for the rural population.[4] That is, it requires 442 children 0–4 years old for each 1000 women 20–44 years old, to maintain New York's total population at its present figure for one generation, assuming no migration, 443 for the urban, and 439 for the rural population.

The question, then, is whether the populations in the various areas of the State are reproduced at these rates.

NATURAL INCREASE IN THE TOTAL POPULATION[5]

New York State population as a whole is not reproducing itself. In fact, it is reproduced at a rate considerably below what is required for maintenance. The index of natural reproduction is 88, or 12 points below the index necessary for replacement.

The native population of the United States as a whole is reproduced at the rate of 112. New York State, when compared with the native population of the United States, is decidedly deficient, 24 points below the rate at which the native population of the country as a whole is reproduced (table 1).

Each type of population in New York State is reproduced at a slower rate than is the native population of the United States. The urban-population replacement rate for the State is 2 points below that for the country as a whole, while the rural rate for the State is 34 points below that of the country as a whole (table 1).

But the total rural population of the State is more than replacing its losses; its reproduction index is 120. The rural farm population is reproduced at the highest rate, 139; and the rural non-farm population is reproduced at the next highest rate, 113.

---

[4] Stated in a letter to the author by Warren S. Thompson of the Scripps Foundation, Miami University, Oxford, Ohio. Dated February 12, 1940.

[5] The number of children 0 to 4 years of age has been increased for each instance in this study by the factor 1.05 to allow for the underenumeration of such children in the 1930 census. That there is an underenumeration is accepted by population students. Warren S. Thompson and P. K. Whelpton have indicated the adjustments necessary in a statement in *Population Trends in the United States*, page 263. The Committee on Population Problems, of the National Resources Board, has stated that this underenumeration should be allowed for in the 1930 census by the factor 1.05 for white population, and 1.11 for the negro population in the Northern States. See *Population Statistics, National Data*, National Resources Committee, October 1937, page 30, for this statement.

Negroes constitute 3 per cent of the New York State population and are concentrated largely in the cities. Since no separate analysis of the negro population is made here, and since their number can affect the indexes computed only very slightly, separate increases were not computed for them. All the increases were made by the same factor, 1.05.

TABLE 1. REPRODUCTION RATES PER GENERATION OF THE TOTAL NEW YORK POPULATION, WITH THE REPRODUCTION RATES OF THE TOTAL NATIVE WHITE POPULATION OF THE UNITED STATES, 1930

Type of population	Per cent of women 20–44 years of age residing in New York State	Index for	
		New York State*	Native white population of United States†
Total population	100.0	88	112
Urban:	87.0	84	86
New York City	59.5	80	. . .
Cities of 100,000 or more	11.6	88‡	76
Cities of 25,000 to 99,999	6.2	87	88
Cities of 10,000 to 24,999	5.4	98	97
Cities of 2,500 to 9,999§	4.3	. . .	104
Rural, total	13.0	120	154
Rural farm	3.7	139	169
Rural non-farm	9.3	113	137

*The indexes for New York State given in this table are slightly higher than similar indexes computed by Bernard D. Karpinos and presented in the *American Journal of Sociology*, vol. 43, no. 2, p. 251 ff, Sept. 1938, and by the Scripps Foundation for Research in Population Problems presented in *Population Index*, p. 268, Oct. 1938. The differences are due to slightly different methods employed and to assumptions followed. The method followed here was that used by the Committee on Population Problems of the National Resources Committee.

†The problems of changing population, p. 134. National Resources Committee, United States Government. May, 1938.

‡Does not include New York City.

§Not computed. Data not available.

The urban population is not replacing its losses. The natural rate of increase for the urban population is only 84, or 16 points below the replacement rate required to maintain this population.

New York City has the low rate of reproduction of 80, while the six other cities of 100,000 or more inhabitants have a rate of 88. Other types of cities of 10,000 or more are all reproducing at rates below 100.

This characteristic of New York urban population to reproduce at a rate below replacement is also true of the urban population of the United States; in fact the reproduction rates for the cities of New York State are not widely different from rates for cities of similar size in other States.

In as much as 87 per cent of the women 20 to 44 years of age in New York State reside in urban areas, the urban type of population influences the natural increase of the State most significantly. When compared with the rural population, which includes but 13 per cent of the women 20 to 44 years of age, and has a natural-increase index of 120, the urban is about four times as important as the rural population in determining the total natural increase. New York City, which includes 59.5 per cent of the women 20 to 44 years of age, and has a reproduction rate of 80, is more than three times as important as the rural population in its influence on the natural reproductive increase of the State. Even though the rural reproduction rate is higher than the urban rate, it cannot make up for the urban deficits in natural reproduction because the rural population includes such a low percentage of women aged 20 to 44.

The rural farm population, though having a natural-increase index of 139, is not as significant in its influence on the rate of natural increase of the State as is the rural non-farm population (index 113), for the number o

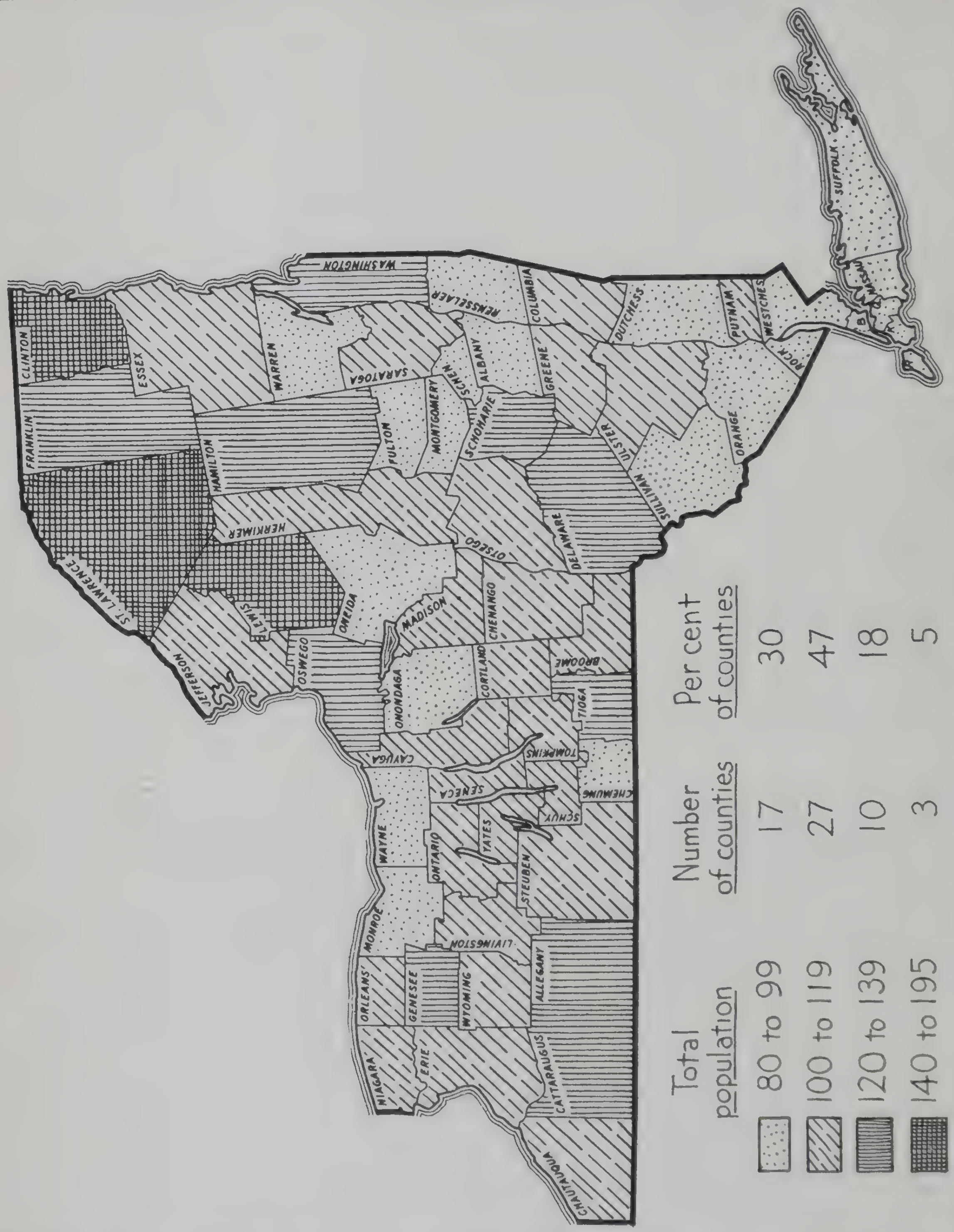

FIGURE 1. INDEX OF NATURAL INCREASE OF THE TOTAL POPULATION OF EACH COUNTY, 1930

The index of natural increase is the actual number of children less than 5 years of age per 1000 women 20 to 44 years of age, divided by the number of children per 1000 women 20 to 44 years of age required to maintain the population at its present size, assuming no migration in or out of the area

women 20 to 44 years of age in rural non-farm[6] population is about three times as large as the number in the farm population.

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[6] The rural non-farm population consists of those persons, living outside of cities and other incorporated places of more than 2500 inhabitants, who do not reside on farms. They include four main classes of inhabitants: 1, residents in incorporated hamlets and villages of less than 2500 persons; 2, residents in unincorporated hamlets and villages; 3, residents in unincorporated suburban districts outside city limits; 4, residents in the open country but not on farms.

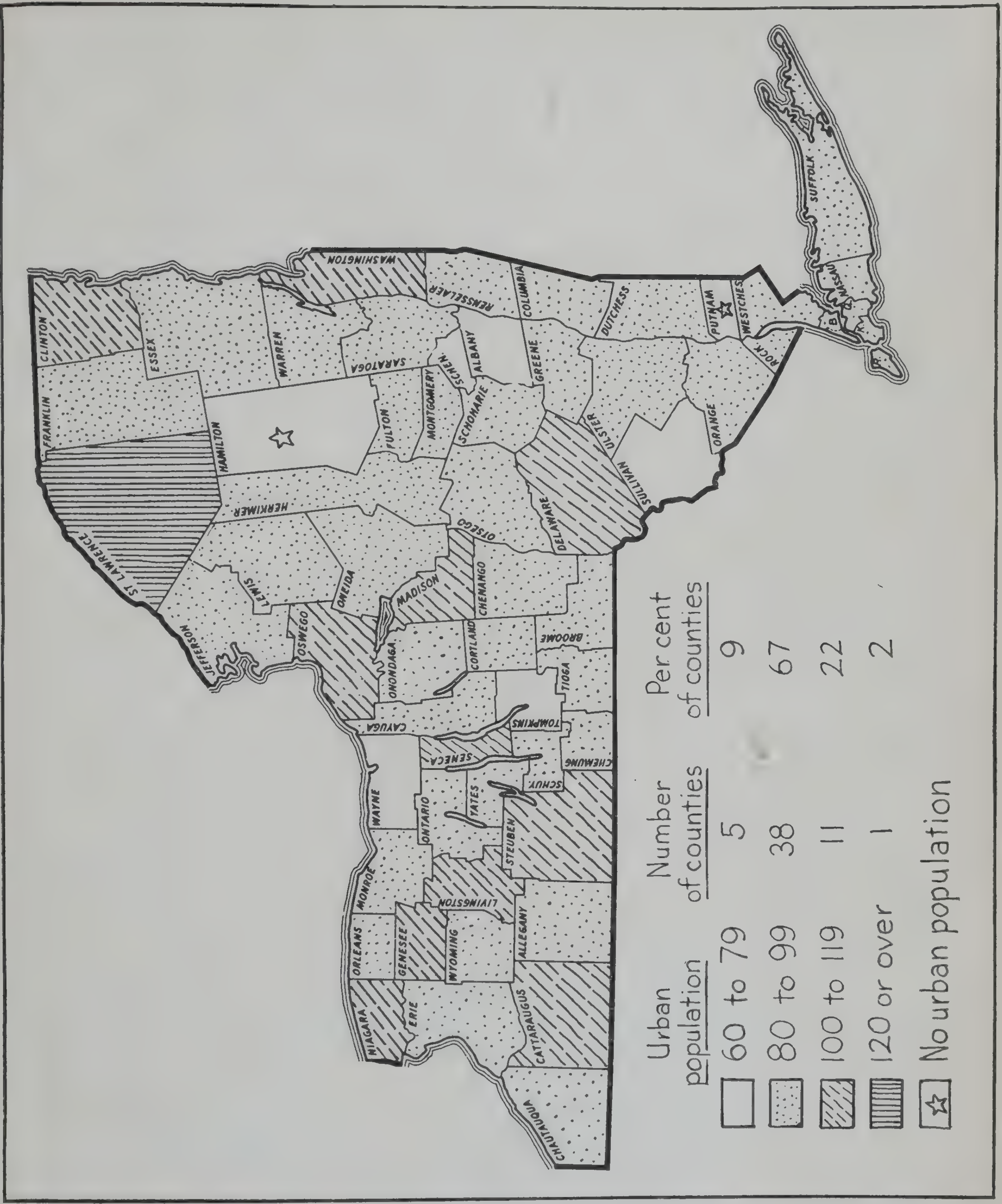

Figure 2. index of natural increase of the urban population in each county, 1930

NATURAL INCREASE BY COUNTIES

Total population. Of the 57 counties of the State, 17 (not including the 5 that compose New York City) have natural-increase indexes of between 80 and 99. Their population losses are not, therefore, being replaced by natural increase. They include a large urban population and must depend upon migration in addition to natural increase for their population maintenance. Most of them are near New York City or in the Great L (Mohawk-Hudson) Valley (figure 1).

Twenty-seven of the counties, nearly one-half, have indexes of 100 to 119. This means that the total population in them is slightly more than replacing its losses. These counties are predominantly rural in composition or include foreign-born populations that are still reproducing at a high rate (figure 1).

Thirteen of the counties, one of each four, have indexes of 120 to 159. They are all rural counties, predominantly farming, and are in both the Southern Tier and the northern mountain area. From these counties, the excess population moves into the counties with low reproduction rates, and this is a chief reason why the latter do not actually decline in numbers.

Urban population by counties. The urban population (persons residing in cities and incorporated places of 2500 or more inhabitants) has indexes of less than 100 in 43 of the 55 counties that include such population. Thus, in four of each five counties the urban population cannot maintain itself except as migration to the cities takes place. In five of the 43 counties the index of natural increase for the urban population is less than 80, indicating that natural increase is deficient for replacement by more than one-fifth (figure 2).

This is at a natural rate below that of New York City. Two of these, Albany and Schenectady, include large cities and are metropolitan areas. But Sullivan, Tompkins, and Wayne are, in the main, rural counties. Urban natural reproduction in Tompkins County may be low because of the presence in Ithaca of a large number of unmarried women 20 to 44 years of age, employed, as teachers, clerical workers, and secretaries, in the educational institutions. Sullivan County has less than 7000 urban residents. Wayne has about 15,000 urban dwellers, but is predominantly a farm county. Perhaps the low natural-reproduction rate of the urban women is accounted for by the presence in the urban areas of a large number of unmarried farm women who have migrated to these centers for work.

The 12 counties in which the urban population has indexes of natural increase of 100 or more contain few cities of large size. They are predominantly rural counties or else comprise a fairly high percentage of foreign-born persons. Seven of these counties have indexes just slightly above 100; thus their urban populations are not reproduced in any significant excess. One county, St. Lawrence, has an index of urban natural increase of 120. This is the highest county index for urban population in the State. It is explained by the presence in the urban population of a large percentage of French-Canadian Catholics (figure 2).

Total rural population by counties. The total rural population is maintaining itself in all but three of the counties of the State, Suffolk, Westchester, and Dutchess. In Suffolk and Westchester, the very large rural non-farm population, relative to the rural farm population, depresses the index for the total rural population; the rural non-farm population has in both counties indexes of less than 100.

In Westchester, the farm population has an index of only 75, and the rural non-farm population, an index of 96. Westchester has little farm population within its borders. There are only 591 women 20 to 44 years of age on farms in the county, so that this index of reproduction is not an important component of the total state index (figure 3).

In 19 counties, the rural population shows an increase of less than 20 per cent, but in the other 35 counties the increase is 20 to 82 per cent. Clinton County, in the northeastern corner of the State, has the highest index, 182. Of the 35 counties with increases of more than 20 per cent, 26 have increases of 20 to 39 per cent.

The total rural-population increase in a given county is influenced, of course, by the proportions comprising farmers and non-farmers. In most of the counties that show only slight rural increases, the rural population is composed mainly of non-farmers, while in those that show large rural increases the population is largely farmers.

Rural farm population by counties. The rural farm population increases at the highest natural rate. For the whole State the rate of natural increase of the farm population is 139.

Two counties, Westchester and Rockland, show natural increases in the farm population that are smaller than replacement requirements. But neither of the two counties has a large enough farm population to be of importance in the total state situation. They are counties that are suburban to New York City and include primarily urban and rural non-farm residents (figure 4).

Of the 55 counties, 53 have indexes of natural increase in the farm population that are equal to or greater than that required for replacement. Of these, 32 increase at a rate of 40 to 95 per cent per generation. These counties with high natural increases in the farm population are mostly in the northern part of the State and along the southern border. The counties that include the largest cities, do not show as high natural rates of increase in the farm population as do those with no cities or with small ones (figure 4).

Rural non-farm population. The rural non-farm population of the whole State shows a natural increase of 13 per cent in excess of that required for replacement.

In four counties, Montgomery, Dutchess, Westchester, and Suffolk, the natural rate of increase is less than 100, while in Seneca County the index is only 65, or 35 per cent below replacement. In Dutchess, Westchester, and Suffolk, the index is influenced by New York City, while in Montgomery it is undoubtedly influenced by Albany and Schenectady. Seneca, however, is a distinctly rural county. It does not have a large non-farm population (figure 5).

In 30 counties, the rural non-farm population is increasing just in excess of the need for replacement. These counties are distributed generally throughout the State.

The 22 counties which show rates of increase of 20 per cent or more per generation are also generally distributed, but those with very high rates of increase are in the northern area (figure 5).

In six of the counties the natural rate of increase is 40 to 72 per cent in excess of that required for replacement. Four of these, Clinton, Lewis, Franklin, and St. Lawrence, are northern valley and mountain counties which have large French-Canadian Catholic populations. Broome County in the Southern Tier, has a high rate of natural increase in its non-farm population. This is due to the large number of foreign-born residents working in Binghamton, Endicott, and Johnson City who live in unincorporated village and rural territory. Genesee County, which is a farming county primarily, shows a high rate of natural increase for its non-farm population

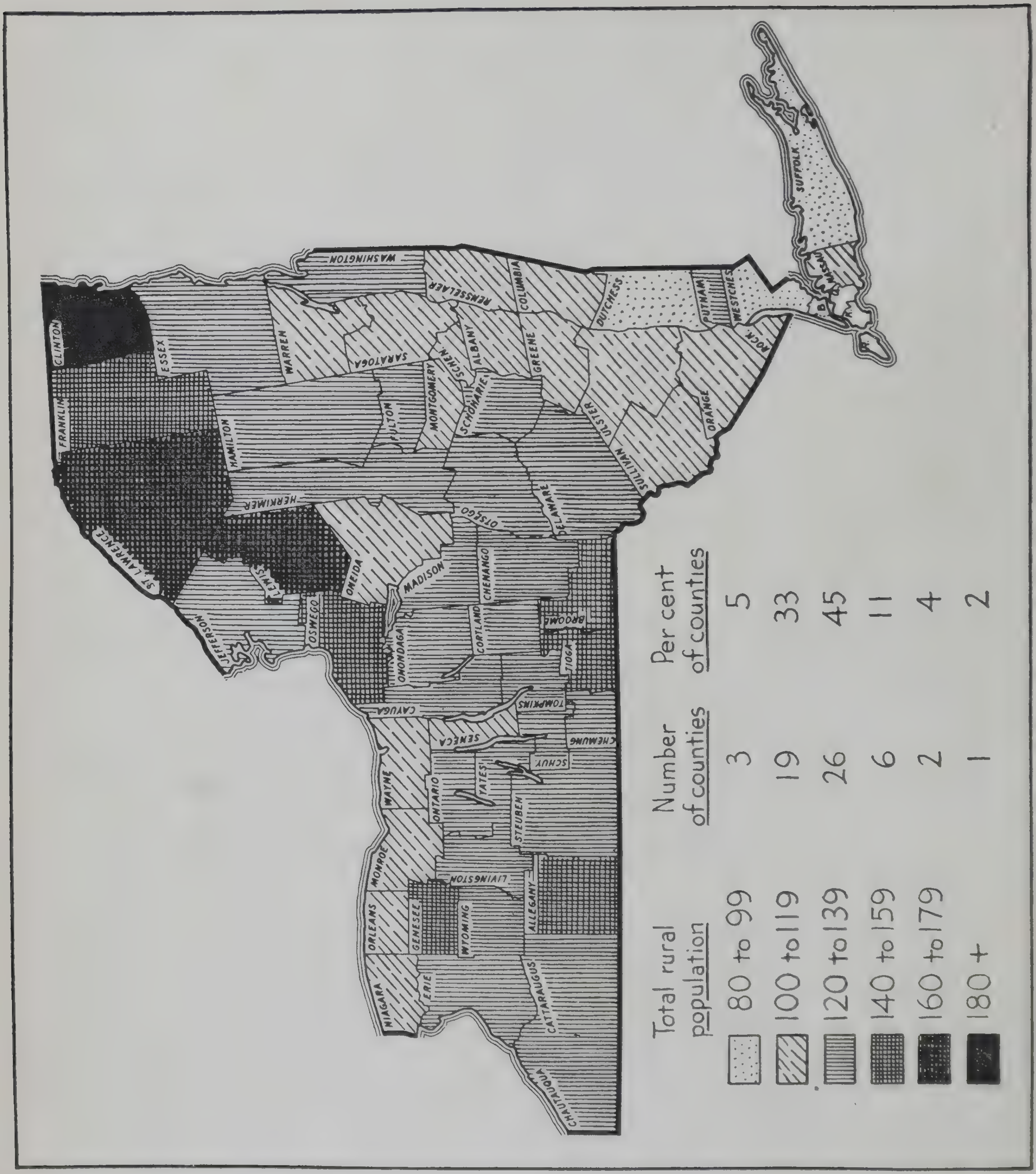

FIGURE 3. INDEX OF NATURAL INCREASE OF THE TOTAL RURAL POPULATION, 1930

as well as for its farm population. This is probably accounted for by the fairly large number of foreign-born inhabitants who reside in rural areas and work in the gypsum and other industrial enterprises.

In eight counties (Albany, Essex, Genesee, Greene, Hamilton, Rockland, Schenectady, and Sullivan), the index of natural increase of the rural non-farm population exceeds the index of natural increase of the farm population. But in only two, Hamilton and Rockland, is this excess as great as ten points, and in both of these the farm population is very small. In the other six, the indexes are almost the same.

On the other hand, in 38 counties the index of natural increase of the farm population exceeds that of the non-farm population by ten per cent.

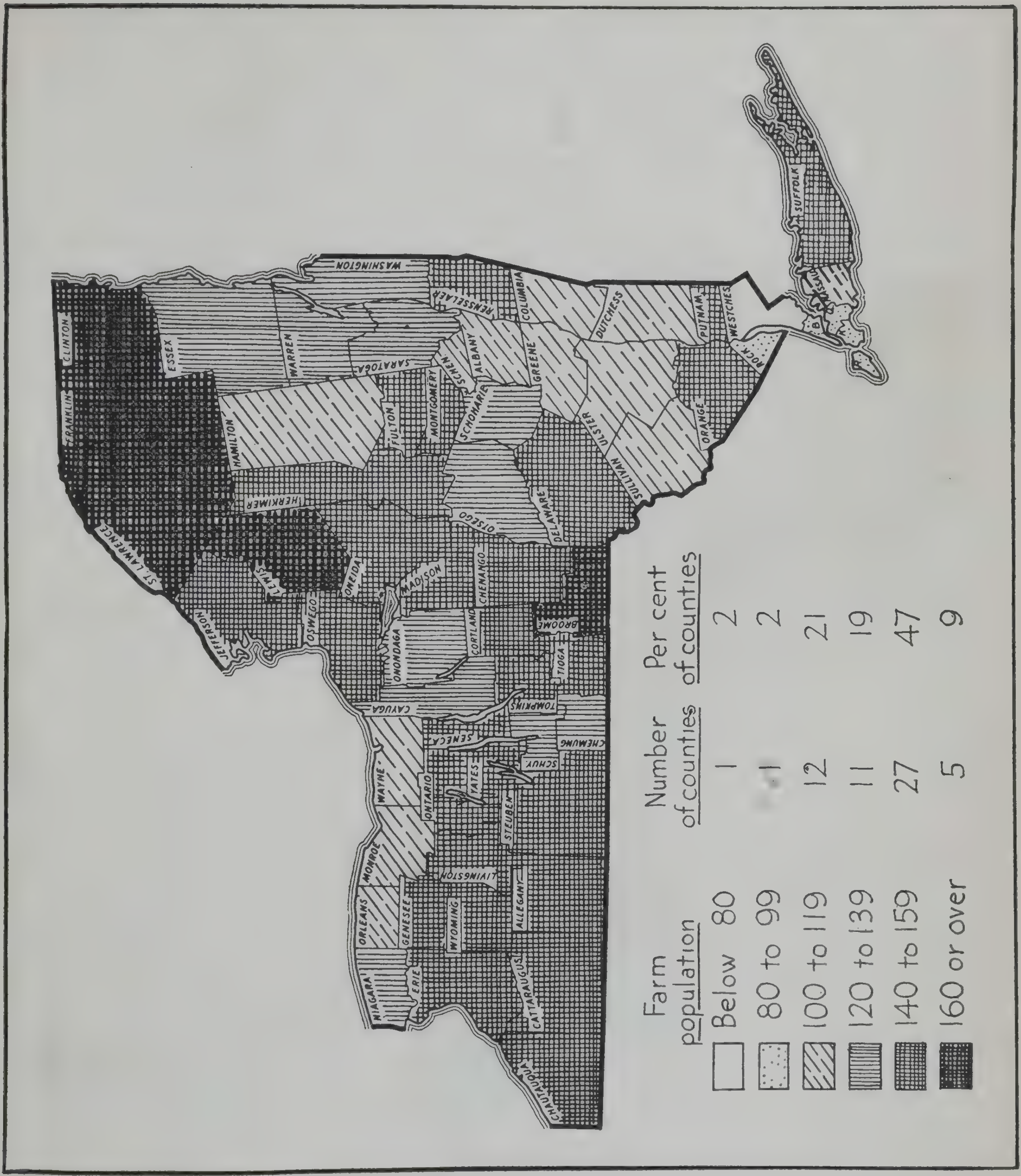

FIGURE 4. INDEX OF NATURAL INCREASE IN THE FARM POPULATION BY COUNTIES, 1930
The two extreme counties are Westchester and Clinton, the former with an index of 75 and the latter with an index of 195

while in 27 of these the excess was 20 or more per cent; thus it is apparent that the natural increase of rural population is influenced mainly by the large natural increase in the farm population.

NATURAL INCREASE BY GEOGRAPHIC AREAS

"Topographically, New York appears as a clear framework of hills separated by a Great L valley system. The latter is a belt stretching eastward from Lake Erie along Lake Ontario across the center of the State to the Hudson River, which, with its bordering lowlands, reaches south-

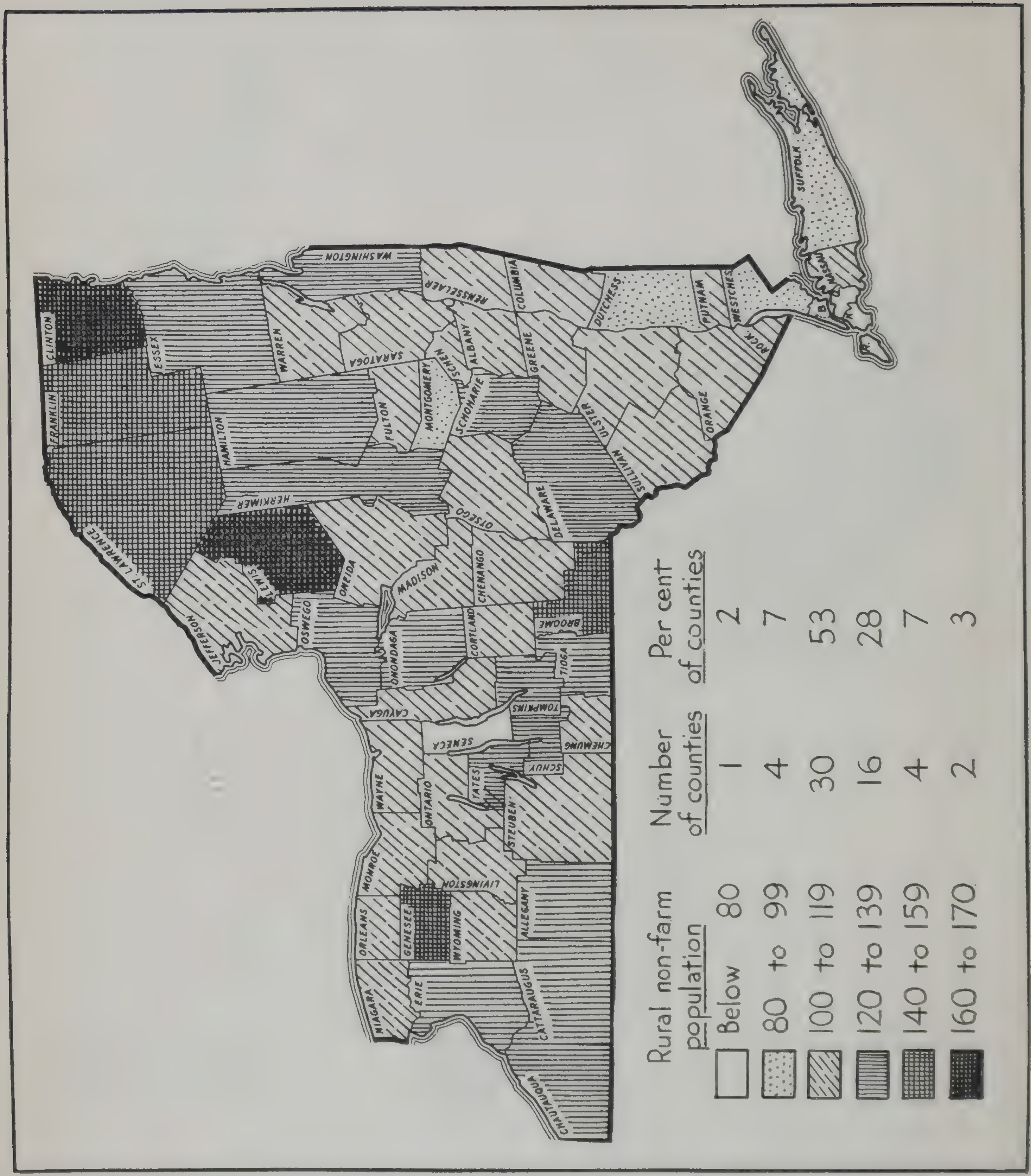

FIGURE 5. INDEX OF THE NATURAL INCREASE IN THE RURAL NON-FARM POPULATION, 1930

ward to the sea."[7] That this is true is clearly seen from figure 6, in which these areas are outlined. The same report further states that "the drift of population was not merely from country to city, it was from the rest of the State to the Valley system—where most of the big cities established themselves."[8] The location of the cities is indicated in figure 6.

New York State includes topographically, therefore, three major areas.

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[7] *From Report of the Commission on Housing and Regional Planning to Governor Alfred E. Smith, May 7, 1926*, p. 13.

[8] *From Report of the Commission on Housing and Regional Planning to Governor Alfred E. Smith, May 7, 1926*, p. 36.

the Great L (Mohawk and Hudson) Valley,[9] the Northern Valley and Mountain Counties,[10] and the Southern Tier Hill Counties.[11] A fourth area may be indicated, not because of geographic characteristics, but because of the influence of New York City upon it. This area includes the five counties suburban to New York City (Putnam, Rockland, Westchester, Nassau, and Suffolk), and is called herein the *New York City suburban area*. A sixth area may be termed the *Lower Hudson Area*.[12] This region includes six counties, two of which, Columbia and Dutchess, are geographically parts of the Great L Valley and four of which, Greene,

TABLE 2. Index of Natural Increase in the Population of New York State, by Geographic Regions

Region	Total population	Urban	Total rural	Rural farm	Rural non-farm
New York City	80	80	...	...	...
Five counties suburban to New York City	92	86	102	123	101
Lower Hudson Area	97	80	108	118	104
Northern Valley and Mountain Counties:	127	105	146	157	138
5 counties with cities of 10,000 or more	125	103	147	159	138
5 counties without cities of 10,000 or more	132	113	144	152	138
Great L Valley (Mohawk and Hudson)	97	91	120	131	115
Southern Tier	111	93	135	147	126
8 counties with cities of 10,000 or more	108	94	135	148	127
8 counties without cities of 10,000 or more	122	90	134	145	124
Total State	88	84	120	139	113

TABLE 3. Percentage of the Total New York State Population and of the Women 20–44 Years of Age that Reside in the Various Areas of New York State

Area	Per cent total state population in area					Per cent women 20–44 years of age in area				
	Total	Urban	Total rural	Rural farm	Rural non-farm	Total	Urban	Total rural	Rural farm	Rural non-farm
New York City	55.1	55.1	0	0	0	59.6	59.5	0	0	0
Five counties suburban to New York City	8.4	5.0	3.4	0.2	3.2	8.4	5.2	3.2	0.1	3.1
Lower Hudson	3.3	1.5	1.8	0.6	1.4	2.8	1.5	1.4	0.4	1.0
Northern Valley and Mountain Area:	3.8	1.6	2.2	1.0	1.2	2.9	1.3	1.6	0.7	0.9
5 counties with cities of 10,000 or more	2.6	1.2	1.4	0.7	0.7	2.0	1.0	1.0	0.5	0.6
5 counties without cities of 10,000 or more	1.2	0.4	0.8	0.4	0.5	0.9	0.3	0.6	0.2	0.4
Great L Valley	22.7	17.2	5.6	2.1	3.4	20.8	16.5	4.3	1.4	2.9
Southern Tier	6.7	3.3	3.4	1.6	1.8	5.5	3.0	2.5	1.1	1.4
8 counties with cities of more than 10,000	5.0	2.9	2.1	0.9	1.1	4.2	2.7	1.5	0.6	0.9
8 counties without cities of 10,000 or more	1.7	0.4	1.3	0.7	0.7	1.3	0.3	1.0	0.5	0.5
Total State	100.0	83.6	16.4	5.6	10.8	100.0	87.0	13.0	3.7	9.3

---

[9] The counties included here in the Great L Valley Area are: Erie, Niagara, Orleans, Genesee, Monroe, Livingston, Wayne, Ontario, Seneca, Cayuga, Onondaga, Oneida, Madison, Herkimer, Fulton, Montgomery, Saratoga, Schenectady, Albany, and Rensselaer.

[10] The counties included in the Northern Valley and Mountain Area are: Oswego, Jefferson, Lewis, St. Lawrence, Franklin, Clinton, Essex, Warren, Hamilton, and Washington.

[11] The counties included in the Southern Tier Hill Area are: Chautauqua, Cattaraugus, Wyoming, Allegany, Steuben, Yates, Schuyler, Chemung, Tioga, Tompkins, Cortland, Broome, Chenango, Otsego, Delaware, Schoharie.

[12] The counties of the Lower Hudson Area are: Columbia, Dutchess, Greene, Sullivan, Ulster, and Orange.

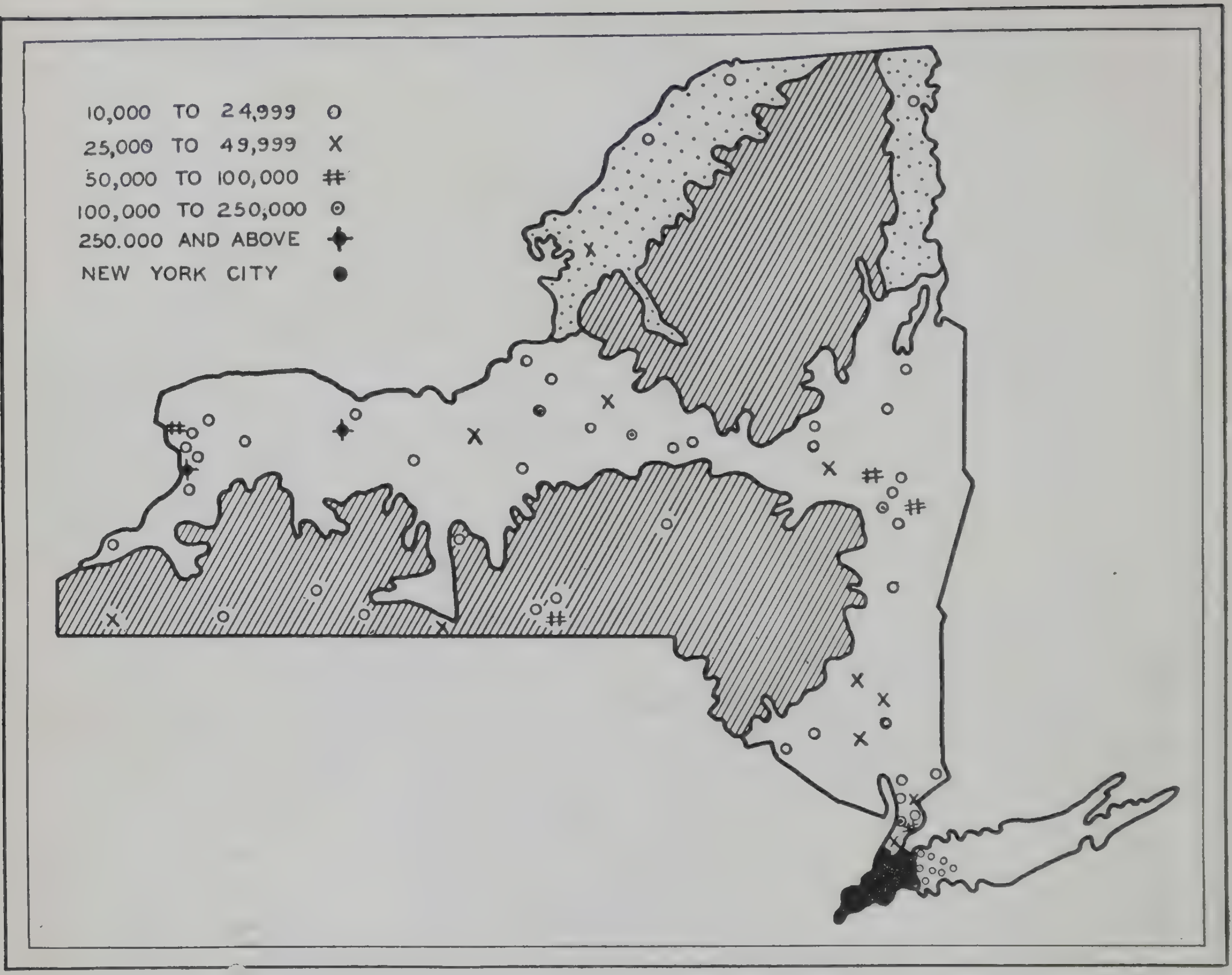


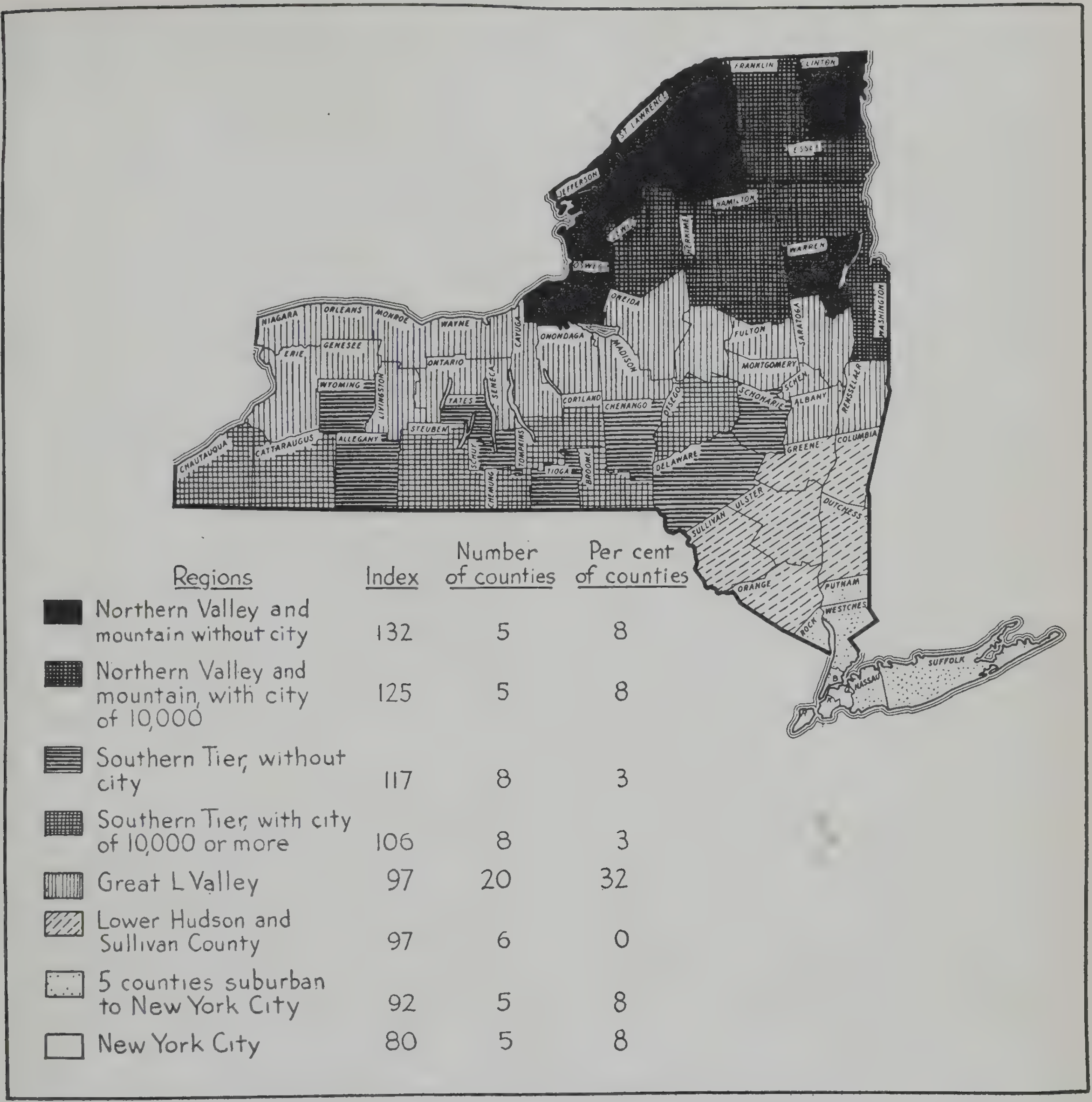
FIGURE 6. CHIEF TOPOGRAPHICAL AREAS OF NEW YORK STATE AND THE LOCATION OF CITIES OF 10,000 OR MORE INHABITANTS

The Great L (Mohawk and Hudson) Valley stretches across the center of the State from the west to the Hudson River and then south to the ocean. In this area are most of the large cities. The Northern Mountain and Valley Area and the Southern Tier Hill Area include only a few of the large cities of the State

Sullivan, Ulster and Orange are geographically parts of the Southern Tier. But these six Lower Hudson counties comprise a fairly homogeneous region of resorts and estates, and are therefore treated here as a separate area.

The Northern Valley and Mountain Area has higher indexes of natural population reproduction in each type of population than has any other area of the State. Its rural farm index, 157, is 18 per cent higher than that of the State as a whole, 139; it is 10 per cent higher than that of the Southern Tier, 147. And in the other types of population, rural non-farm, urban, and total, its indexes are 20 to 35 per cent higher than for the similar populations in the State as a whole, and 10 to 16 points higher than the indexes of the similar population in the Southern Tier (figure 7).

The Northern Valley and Mountain Area is predominantly rural, with only 5 cities of 10,000 or more inhabitants and one with a population of nearly 35,000. Likewise, it contains a considerable French-Canadian population, Catholic in religion, which has a high reproduction rate. These two factors explain the high reproduction indexes of the area. Even the urban population of this area is slightly above replacement requirements, which is not true of any of the other areas (figure 7).



Regions	Index	Number of counties	Per cent of counties
■ Northern Valley and mountain without city	132	5	8
▦ Northern Valley and mountain, with city of 10,000	125	5	8
▤ Southern Tier, without city	117	8	3
▦ Southern Tier, with city of 10,000 or more	106	8	3
▥ Great L Valley	97	20	32
▨ Lower Hudson and Sullivan County	97	6	0
⬚ 5 counties suburban to New York City	92	5	8
□ New York City	80	5	8

FIGURE 7. INDEX OF NATURAL INCREASE IN THE TOTAL POPULATION BY REGIONS, 1930

The Southern Tier ranks next among the areas in its natural replacement indexes. The total population is being reproduced at a rate slightly higher than replacement requirements, while the farm population exceeds the replacement requirements by 47 per cent. The urban population losses of the area are not being replaced (index 93) but the non-farm population exceeds replacement requirements by 26 per cent.

The Southern Tier is predominantly a hilly rural region. Eight of the 16 counties included herein as parts of the area, have no city with as many as 10,000 inhabitants. Of the counties with cities of 10,000 or more inhabitants, only Broome, Chemung, and Chautauqua have cities of more than 25,000 inhabitants. The other cities of more than 10,000 inhabitants, nine in all, have populations of between 10,000 and 25,000. Although the populations of these cities are below replacement requirements, the rural population does produce a considerable excess for its replacement, so that the total for the area is slightly above replacement requirements (table 2 and figure 7).

The Great L (Mohawk and Hudson) Valley Area is not replacing its population. The index of natural reproduction for the whole area is 97, or 3 per cent below replacement requirements. The farm and non-farm population of this area is above replacement, index 131 and 115, but the proportion of urban population in the area is so large that the excess natural reproduction of the rural population cannot make up for the deficient natural reproduction of the urban population.

The population of the Lower Hudson Area is being replaced at the same rate as that in the Great L Valley. The index of natural increase of the total population is 97. The index of natural increase of the urban population of this area is as low as the index of natural increase for New York City, 80. The total rural, rural farm, and rural non-farm populations, though increasing at a rate slightly higher than that necessary for replacement, show natural increases much smaller than those in the Southern Tier or in the Northern Valley and Mountain Area (table 2 and figure 7).

Likewise, the population of the five-county area suburban to New York City is not being replaced by natural reproduction. The index of natural increase for the area as a whole is 92, 8 per cent below requirements for replacement. The index of reproduction for the urban population is only 86. The total rural population losses of the area are barely being replaced, index 102. The rural non-farm population has an index of 101, while the farm population has an index of 123, or almost one-fourth more than is needed for its own replacement (table 2).

There are, therefore, three areas, the Great L Valley, the Lower Hudson Area, and the New York City Suburban Area, in which the population is below replacement requirements. These together with New York City, include 89.5 per cent of the State's population and 91.6 per cent of the women 20 to 44 years of age. Their greater influence upon the natural increase in the State's population is obvious. Even though the populations of the Northern Valley and Mountain Area and the Southern Tier are above replacement requirements, since they include but 10.5 per cent of the State's population and only 8.4 per cent of the women 20 to 44 years of age, the rate of natural increase for the State must be below that required to maintain the population.

SOCIAL IMPLICATIONS

Several important social implications result from these facts about the natural increase in the counties, the areas, and the State as a whole.

Since losses in New York population are not replaced by natural methods, if the population remains at its present size, not to suggest increase, there will continue to be considerable migration to it from without and much migration between areas within. It will continue to be an area of absorption for excess population produced elsewhere. In 1930, 37.8 per cent, or almost 4 of each 10 of its inhabitants were born outside the State.[13] If natural increase continues at its present rate, this proportion must increase.

Mobility within the State is also likely to increase. There will be a continued flow of population from the areas where excess natural increase takes place, the Northern Mountain and the Southern Tier Hill Areas, to the cities of underproduction within these areas and to the Great L Valley Area, the Lower Hudson Area, the New York City Suburban Area, and New York City itself.

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[13] Movement of population to and from New York State. By W. A. Anderson. Cornell Univ. Agr. Exp. Sta. Bul. 591. 1934.

In a State like New York, which is so predominantly urban, this migration, both from without and within, is likely to show a greater proportion of women than of men moving into the areas of population underproduction. As of 1930, only 97 men to every 100 women came to New York, while, of those leaving New York State for other areas, there were 103 men to every 100 women.[14] Likewise the rural area of the State cannot absorb the women in economically productive activities as effectively as it can the men, so that larger proportions of women than of men move to the urban regions. But the excess population both of men and women, which seems to be about seven of every ten of the young people reared in the rural areas of the State, migrate into these urban regions of population underproduction.

The population moving into New York State is chiefly adult. That which is native is already reared and educated at the expense of the areas of production. Such populations enter the State at their productive period and thus the State benefits. But the foreign and the negro population must be assimilated into the new cultural situation and this demands programs of citizenship training.

The migration of excess population from the rural areas of population overproduction to the urban areas of underproduction means that the rural areas bear the cost of rearing and educating these persons for their productive use by the urban regions. Adjustment of these costs must be made if the rural areas are to maintain adequate institutions for the proper training of the youths they rear for the cities.

Institutions and organizations in the rural areas, especially those of a voluntary type such as the church, suffer particularly from this migration, for the young people migrate just when they could begin to contribute support and leadership. Such institutions and organizations show abnormally high proportions of children and older people in their membership.

From the urban point of view, there is also the problem of attracting these migrants from the rural areas to constructive community-building agencies.

Another question of social importance raised by these facts is whether the excess population is being produced by those who are least fitted to bear and rear children. This question requires special study, but it has been suggested that, at least from an economic and perhaps from a social and educational point of view, the population groups best fitted to bear and rear larger numbers of children are not doing so, while those least fitted reproduce at the higher rates.

There is likewise the problem of the effect of higher rates of natural reproduction in an area or by a class upon levels of living. Are the urban classes reproducing at low rates in order to maintain standards of living, at least in the material sense? Does natural reproduction at high rates mean the sacrifice of standards of living? These questions are not answered by findings of this study, but these findings do raise the questions.

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[14] Movement of population to and from New York State. By W. A. Anderson. Cornell Univ. Agr. Exp. Sta. Bul. 591. (Reference on p. 33.) 1934.

APPENDIX

TABLE 4. INDEX OF NATURAL INCREASE, WITH THE FIGURES FOR COMPUTATION, FOR THE TOTAL POPULATION OF NEW YORK STATE BY COUNTIES, 1930

County	Number of children 0–4 years of age*	Number of women 20–44 years of age	Number of children 0–4 years of age per 1000 women aged 20–44	Index of natural increase (ratio of children to women, divided by 442)
Albany	16,274	43,950	370	84
Allegany	3,575	6,122	584	132
Bronx	109,124	296,974	367	83
Broome	13,771	28,886	477	108
Cattaraugus	6,726	12,521	537	121
Cayuga	4,927	10,730	459	104
Cheutauqua	10,802	22,784	474	107
Chemung	6,012	14,061	428	98
Chenango	2,732	5,581	490	111
Clinton	4,775	7,134	669	151
Columbia	3,029	6,740	449	102
Cortland	2,510	5,519	455	103
Delaware	3,698	6,539	566	128
Dutchess	7,901	19,457	406	92
Erie	69,195	154,804	447	101
Essex	3,110	5,928	525	119
Franklin	4,415	7,914	558	126
Fulton	3,423	8,330	411	93
Genesee	4,212	7,301	577	130
Greene	1,925	4,075	472	107
Hamilton	361	624	579	131
Herkimer	5,039	11,007	458	104
Jefferson	7,006	14,389	487	110
Kings	224,508	558,083	402	91
Lewis	2,360	3,504	674	152
Livingston	3,209	6,147	522	118
Madison	3,269	6,289	520	118
Monroe	33,347	87,003	383	87
Montgomery	4,559	11,106	410	93
Nassau	28,368	66,552	426	96
New York	119,501	449,163	266	60
Niagara	13,890	28,225	492	111
Oneida	16,197	36,863	439	99
Onondaga	24,560	57,041	431	97
Ontario	4,532	9,220	492	111
Orange	9,979	23,494	425	96
Orleans	2,153	4,666	461	104
Oswego	6,092	11,221	543	123
Otsego	3,581	7,687	466	105
Putnam	1,218	2,316	526	119
Queens	95,055	248,544	382	86
Rensselaer	8,673	23,365	371	84
Richmond	14,192	30,455	466	105
Rockland	4,818	10,938	440	99
St. Lawrence	9,085	14,581	623	141
Saratoga	5,028	10,994	457	103
Schenectady	9,225	25,142	367	83
Schoharie	1,603	2,929	547	124
Schuyler	1,019	1,942	525	119
Seneca	1,810	3,819	474	107
Steuben	7,290	13,953	522	118
Suffolk	12,993	30,304	429	97
Sullivan	2,608	6,073	429	97
Tioga	2,162	3,959	546	123
Tompkins	3,376	7,419	455	102
Ulster	6,274	13,923	451	102
Warren	2,672	6,473	413	93
Washington	4,003	7,500	534	121
Wayne	3,560	8,722	408	92
Westchester	43,793	114,265	383	87
Wyoming	2,312	4,491	515	116
Yates	1,344	2,650	507	115
Total	1,038,760	2,662,391	390	88

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*The United States Census for 1930, volume 3, number 2 (*Population, Composition and Characteristics*), gives the number of children 0 to 4 years of age by counties, etc. These figures were increased by the factor 1.05 to allow for underenumeration, as previously indicated on page 4.

TABLE 5. INDEX OF NATURAL INCREASE, WITH THE FIGURES FOR COMPUTATION, FOR THE URBAN POPULATION OF NEW YORK STATE BY COUNTIES, 1930

County	Number of children 0–4 years of age*	Number of women 20–44 years of age	Number of children 0–4 years of age per 1000 women aged 20–44	Index of natural increase (ratio of children to women, divided by 443)
Albany	12,746	36,565	349	79
Allegany	477	1,114	428	97
Bronx	109,124	296,974	367	83
Broome	9,192	22,079	416	94
Cattaraugus	3,050	6,390	477	108
Cayuga	2,756	6,660	414	93
Chautauqua	6,570	15,385	427	96
Chemung	3,900	10,157	384	87
Chenango	604	1,660	364	82
Clinton	1,254	2,717	462	104
Columbia	898	2,227	403	91
Cortland	1,313	3,498	375	85
Delaware	291	609	478	108
Dutchess	4,479	10,963	409	92
Erie	58,962	137,109	430	97
Essex	754	1,830	412	93
Franklin	1,748	4,081	428	97
Fulton	2,373	6,444	368	83
Genesee	1,979	3,937	503	114
Greene	373	894	417	94
Hamilton†				
Herkimer	3,108	7,718	403	91
Jefferson	2,989	7,203	415	94
Kings	224,508	558,083	402	91
Lewis	267	611	437	99
Livingston	689	1,404	491	110
Madison	1,234	2,600	475	107
Monroe	27,481	75,190	365	82
Montgomery	2,975	7,899	377	85
Nassau	12,081	31,479	384	87
New York	119,501	449,163	266	60
Niagara	11,277	23,234	485	110
Oneida	11,897	28,336	420	95
Onondaga	18,444	46,145	400	90
Ontario	1,908	4,457	428	97
Orange	5,147	14,180	363	82
Orleans	802	1,960	409	92
Oswego	2,923	6,188	472	107
Otsego	1,112	3,123	356	80
Putnam				
Queens	95,055	248,544	382	86
Rensselaer	6,199	18,152	356	80
Richmond	14,192	30,455	466	105
Rockland	1,779	4,226	421	95
St. Lawrence	3,651	6,882	531	120
Saratoga	2,638	6,298	419	95
Schenectady	7,375	21,020	351	79
Schoharie	186	482	386	87
Schuyler	215	535	402	91
Seneca	836	1,711	489	110
Steuben	3,336	7,328	455	103
Suffolk	2,518	6,082	414	94
Sullivan	499	1,463	341	77
Tioga	800	1,820	440	99
Tompkins	1,481	4,239	349	79
Ulster	2,676	6,886	389	88
Warren	1,372	3,840	357	81
Washington	1,719	3,451	498	112
Wayne	842	3,173	265	60
Westchester	36,779	97,438	377	85
Wyoming	517	1,455	355	80
Yates	350	975	359	81
Total	856,197	2,316,721	370	84

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*The United States Census for 1930, volume 3, number 2 (*Population, Composition and Characteristics*), gives the number of children 0 to 4 years of age by counties, etc. These figures were increased by the factor 1.05 to allow for underenumeration as previously indicated on page 4.

†No urban population.

TABLE 6. INDEX OF NATURAL INCREASE, WITH THE FIGURES FOR COMPUTATION, FOR THE TOTAL RURAL POPULATION OF NEW YORK STATE BY COUNTIES, 1930

County	Number of children 0–4 years of age*	Number of women 20–44 years of age	Number of children 0–4 years of age per 1000 women aged 20–44	Index of natural increase (ratio of children to women, divided by 439)
Albany	3,528	7,385	478	109
Allegany	3,099	5,008	619	141
Bronx†				
Broome	4,579	6,807	673	153
Cattaraugus	3,676	6,131	600	137
Cayuga	2,170	4,070	533	121
Chautauqua	4,233	7,399	572	130
Chemung	2,113	3,904	541	123
Chenango	2,128	3,921	543	124
Clinton	3,522	4,417	797	182
Columbia	2,132	4,513	472	108
Cortland	1,197	2,021	592	135
Delaware	3,407	5,930	575	131
Dutchess	3,422	8,494	403	92
Erie	10,233	17,695	578	132
Essex	2,356	4,098	575	131
Franklin	2,667	3,833	696	159
Fulton	1,050	1,886	557	127
Genesee	2,232	3,364	663	151
Greene	1,552	3,181	488	111
Hamilton	361	624	579	132
Herkimer	1,931	3,289	587	134
Jefferson	4,016	7,186	559	127
Kings†				
Lewis	2,093	2,893	723	165
Livingston	2,520	4,743	531	121
Madison	2,035	3,689	552	126
Monroe	5,866	11,813	497	113
Montgomery	1,584	3,207	494	113
Nassau	16,287	35,073	464	106
New York				
Niagara	2,613	4,991	524	119
Oneida	4,301	8,527	504	115
Onondaga	6,115	10,896	561	128
Ontario	2,624	4,763	551	126
Orange	4,832	9,314	519	118
Orleans	1,350	2,706	499	114
Oswego	3,169	5,033	630	144
Otsego	2,469	4,564	541	123
Putnam	1,218	2,316	526	120
Queens†				
Rensselaer	2,474	5,213	475	108
Richmond†				
Rockland	3,040	6,712	453	103
St. Lawrence	5,434	7,699	706	161
Saratoga	2,391	4,696	509	116
Schenectady	1,850	4,122	449	102
Schoharie	1,418	2,447	579	132
Schuyler	803	1,407	571	130
Seneca	974	2,108	462	105
Steuben	3,954	6,625	597	136
Suffolk	10,475	24,222	432	98
Sullivan	2,109	4,610	457	104
Tioga	1,362	2,139	637	145
Tompkins	1,895	3,180	596	136
Ulster	3,597	7,037	511	116
Warren	1,300	2,633	494	113
Washington	2,284	4,049	564	128
Wayne	2,717	5,549	490	112
Westchester	7,014	16,827	417	95
Wyoming	1,796	3,036	592	135
Yates	994	1,675	593	135
Total	182,562	345,670	528	120

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*The United States Census for 1930, volume 3, number 2 (*Population, Composition and Characteristics*), gives the number of children 0 to 4 years of age by counties, etc. These figures were increased by the factor 1.05 to allow for underenumeration as previously indicated on page 4.

†No rural population.

TABLE 7. INDEX OF NATURAL INCREASE, WITH THE FIGURES FOR COMPUTATION, FOR THE RURAL FARM POPULATION OF NEW YORK STATE BY COUNTIES, 1930

County	Number of children 0–4 years of age*	Number of women 20–44 years of age	Number of children 0–4 years of age per 1000 women aged 20–44	Index of natural increase (ratio of children to women, divided by 439)
Albany	627	1,394	450	103
Allegany	1,413	2,045	691	157
Bronx†				
Broome	1,281	1,775	722	164
Cattaraugus	1,597	2,414	662	151
Cayuga	1,234	2,125	581	132
Chautauqua	2,192	3,543	619	141
Chemung	580	956	607	138
Chanango	1,147	1,868	614	140
Clinton	1,586	1,853	856	195
Columbia	697	1,350	516	118
Cortland	793	1,213	654	149
Delaware	1,607	2,596	619	141
Dutchess	896	1,738	516	117
Erie	2,399	3,872	620	141
Essex	576	1,033	558	127
Franklin	1,321	1,748	756	172
Fulton	487	751	648	148
Genesee	1,043	1,604	650	148
Greene	498	1,081	461	105
Hamilton	50	97	515	117
Herkimer	993	1,574	631	144
Jefferson	1,777	2,890	615	140
Kings†				
Lewis	1,133	1,528	741	169
Livingston	1,004	1,495	672	153
Madison	1,092	1,709	639	146
Monroe	1,532	2,983	514	117
Montgomery	752	1,201	626	143
Nassau	320	659	486	111
New York†				
Niagara	1,431	2,636	543	124
Oneida	1,635	2,656	616	140
Onondaga	1,707	2,971	575	131
Ontario	1,388	2,235	621	141
Orange	1,406	2,279	617	141
Orleans	757	1,464	517	118
Oswego	1,802	2,595	694	158
Otsego	1,240	2,110	588	134
Putnam	222	346	642	146
Queens†				
Rensselaer	677	1,435	642	146
Richmond†				
Rockland	87	237	367	84
St. Lawrence	2,978	4,179	713	162
Saratoga	798	1,466	544	124
Schenectady	195	438	445	101
Schoharie	767	1,316	583	133
Schuyler	418	725	577	131
Seneca	631	979	645	147
Steuben	2,118	3,103	683	156
Suffolk	1,083	1,707	634	144
Sullivan	776	1,772	438	100
Tioga	811	1,216	667	152
Tompkins	896	1,365	656	149
Ulster	1,255	2,437	515	117
Warren	298	556	536	122
Washington	983	1,698	579	132
Wayne	1,457	2,844	512	117
Westchester	195	591	330	75
Wyoming	1,036	1,536	674	154
Yates	655	1,056	620	141
Total	60,327	99,043	609	139

*The United States Census for 1930, volume 3, number 2, (*Population, Composition and Characteristics*), gives the number of children 0 to 4 years of age by counties, etc. These figures were increased by the factor 1.05 to allow for underenumeration as previously indicated on page 4.

†No rural farm population.

TABLE 8. INDEX OF NATURAL INCREASE, WITH THE FIGURES FOR COMPUTATION, FOR THE RURAL NON-FARM POPULATION OF NEW YORK STATE BY COUNTIES, 1930

County	Number of children 0–4 years of age*	Number of women 20–44 years of age	Number of children 0–4 years of age per 1000 women aged 20–44	Index of natural increase (ratio of children to women, divided by 439)
Albany	2,901	5,991	484	110
Allegany	1,685	2,963	569	130
Bronx†				
Broome	3,298	5,032	655	149
Cattaraugus	2,079	3,717	559	127
Cayuga	937	1,945	482	110
Chautauqua	2,040	3,856	529	121
Chemung	1,533	2,948	520	118
Chenango	982	2,053	478	109
Clinton	1,936	2,564	755	172
Columbia	1,434	3,163	453	103
Cortland	404	808	500	114
Delaware	1,801	3,334	540	123
Dutchess	2,526	6,756	374	85
Erie	7,834	13,823	567	129
Essex	1,780	3,065	581	132
Franklin	1,346	2,085	646	147
Fulton	563	1,135	496	113
Genesee	1,190	1,760	676	154
Greene	1,054	2,100	502	114
Hamilton	311	527	590	134
Herkimer	938	1,715	547	125
Jefferson	2,240	4,296	521	119
Kings†				
Lewis	961	1,365	704	160
Livingston	1,516	3,248	467	106
Madison	943	1,980	476	108
Monroe	4,334	8,830	491	112
Montgomery	833	2,006	415	95
Nassau	15,966	34,414	464	106
New York†				
Niagara	1,182	2,355	502	114
Oneida	2,666	5,871	454	103
Onondaga	4,408	7,925	556	127
Ontario	1,236	2,528	489	111
Orange	3,426	7,035	487	111
Orleans	593	1,242	477	109
Oswego	1,367	2,438	561	128
Otsego	1,229	2,454	501	114
Putnam	996	1,970	506	115
Queens†				
Rensselaer	1,797	3,778	476	108
Richmond†				
Rockland	2,953	6,475	456	104
St. Lawrence	2,456	3,520	698	159
Saratoga	1,593	3,230	493	112
Schenectady	1,655	3,684	449	102
Schoharie	651	1,131	576	131
Schuyler	385	682	565	129
Seneca	343	1,129	304	69
Steuben	1,836	3,522	521	119
Suffolk	9,392	22,515	417	95
Sullivan	1,334	2,838	470	107
Tioga	551	923	597	136
Tompkins	999	1,815	550	125
Ulster	2,343	4,600	509	116
Warren	1,002	2,077	482	110
Washington	1,301	2,351	553	126
Wayne	1,260	2,705	466	106
Westchester	6,819	16,236	420	96
Wyoming	759	1,500	506	115
Yates	339	619	548	125
Total	122,236	246,627	496	113

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*The United States Census for 1930, volume 3, number 2 (*Population, Composition and Characteristics*), gives the number of children 0 to 4 years of age by counties, etc. These figures were increased by the factor 1.05 to allow for underenumeration as previously indicated on page 4.

†No rural farm population.

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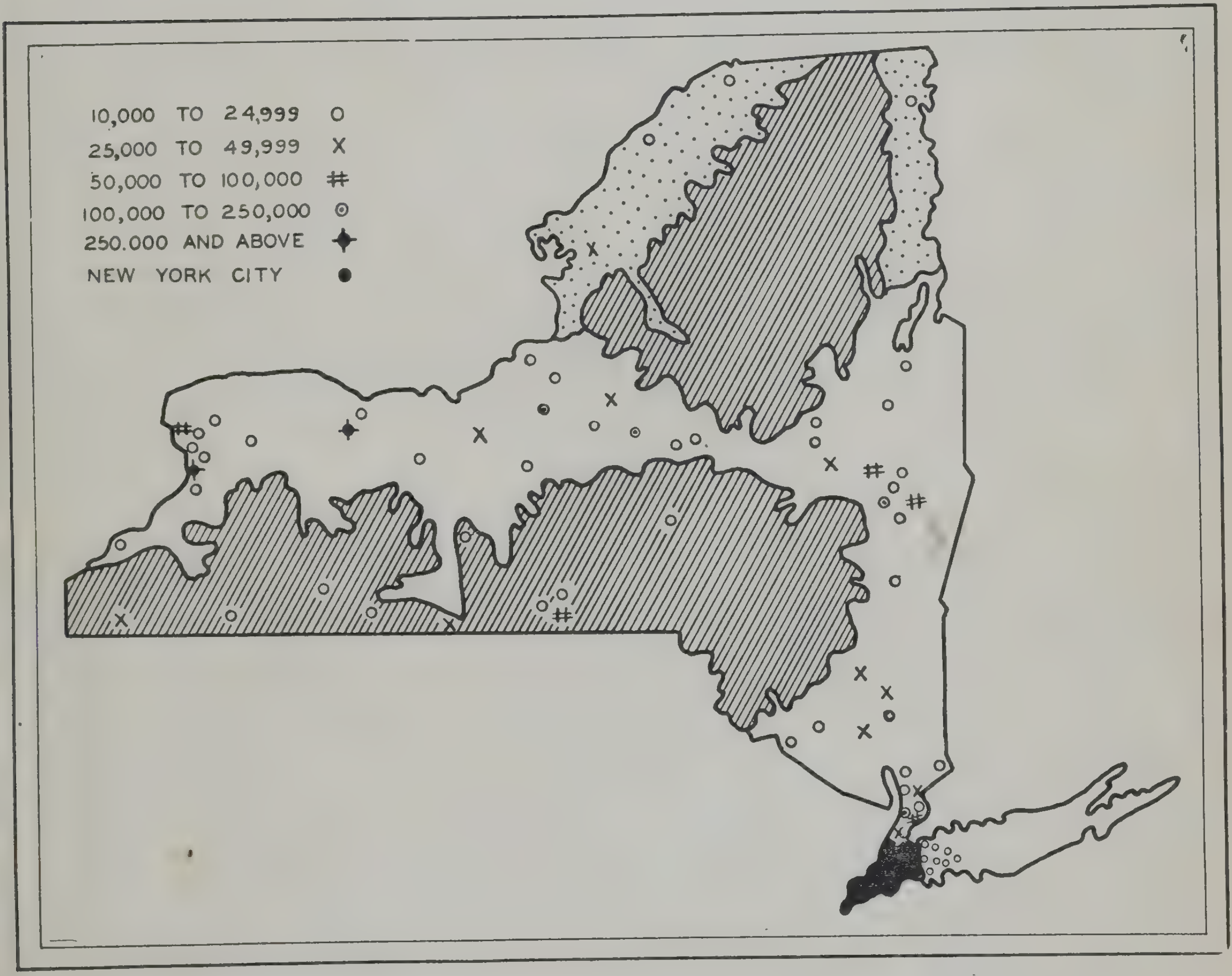
Natural Increase in the Population of New York State

W. A. Anderson



CHIEF TOPOGRAPHICAL AREAS OF THE STATE AND LOCATION OF CITIES OF 10,000 OR MORE POPULATION

Population losses are being replaced naturally in excess in the Northern Mountain and Valley Areas and the Southern Tier Area, while in the Great L Valley and the New York City region population losses are not being replaced

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NATURAL INCREASE IN THE POPULATION OF NEW YORK STATE

W. A. Anderson

This Station has previously published two studies concerning recent changes in the New York State population. The first described the changes which took place in the number and proportions of the classes of the population that lived in various civil divisions between 1910 and 1930.[1] The second treated the net cumulative movement of population to the State from foreign countries and the net cumulative movement to the State from other States.[2]

The present bulletin describes the natural increase in this population. Population changes as a result of net migration, resulting from movement to and from an area; it is also affected by natural change, resulting from the difference between the number of births and deaths in the area. To indicate the influences of population upon social organization, it is important to analyze the trends in the natural increase and to point out the types of population that are reproduced in the area. This also helps to understand probable migration in the area. Such changes have important relations to institutional organization and activity.

THE INDEX OF NATURAL INCREASE

The natural increase in the New York State population is measured in this study through the use of an index. Population experts have devised a method for measuring the natural increase of any population by use of a maintenance ratio of increase related to the actual ratio of children less than 5 years of age to the actual number of women 20 to 44 years of age.

The "Index of Natural Increase" used in this study is the number of children less than 5 years of age per 1000 women 20 to 44 years of age, divided by a replacement ratio. The replacement ratio is the number of children less than 5 years of age per 1000 women aged 20 to 44 in the stationary population which would result from the continual operation of the current mortality rates and in the absence of any migration.[3]

Lorimer and Osborn[3] define the index of natural increase in a similar way. They say "the ratio of the number of births or number of children found in any group under specified conditions to the corresponding replacement ratio gives a reproduction index, or estimated rate of reproduction per generation."

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[1] Population trends in New York State, 1900 to 1930. By W. A. Anderson. Cornell Univ. Agr. Exp. Sta. Bul. 547. 1932.

[2] Movement of population to and from New York State. By W. A. Anderson. Cornell Univ. Agr. Exp. Sta. Bul. 591. 1934.

[3] The number of women 20 to 44 years of age in the urban, rural, and rural non-farm population by counties is not available in the published volumes of the United States Census. The number of women aged 20 to 44 years in the total rural, the farm, and the rural non-farm population was furnished from special tabulations of census data by the Division of Farm Population and Rural Welfare of the Bureau of Agricultural Economics, United States Department of Agriculture, and the Division of Social Research of the Works Progress Administration. The number in the urban population was obtained by subtracting the number in the total rural population from the number in the total population. The data upon which the indexes were computed are included in the series of 5 appendix tables.

The definition of the replacement ratio was furnished by Dr. Harold Dorn, Statistician, United States Health Service.

Lorimer and Osborn. Dynamics of population, p. 399. 1934.

An index of 100 means that there are just enough children 0 to 4 years old to each 1000 women 20 to 44 years of age to replace the persons removed by death in a generation of 28 years. An index of 125 would mean that at the end of the generation of 28 years the area would have one-fourth more population than at the beginning, assuming either no migration in or out of the area or equal migration. An index of 75 would mean a decrease of 25 per cent under the same assumptions. Where the number of children less than 5 years of age and the number of women 20 to 44 years of age in a population are available, the use of such an index makes it possible to show what elements in the population are naturally reproduced.

REPLACEMENT RATIOS

The Scripps Foundation for Research in Population Problems, utilizing life tables available, has computed replacement ratios, as of 1930, of 442 for the total population of New York State, 443, for the urban, and 439 for the rural population.[4] That is, it requires 442 children 0–4 years old for each 1000 women 20–44 years old, to maintain New York's total population at its present figure for one generation, assuming no migration, 443 for the urban, and 439 for the rural population.

The question, then, is whether the populations in the various areas of the State are reproduced at these rates.

NATURAL INCREASE IN THE TOTAL POPULATION[5]

New York State population as a whole is not reproducing itself. In fact, it is reproduced at a rate considerably below what is required for maintenance. The index of natural reproduction is 88, or 12 points below the index necessary for replacement.

The native population of the United States as a whole is reproduced at the rate of 112. New York State, when compared with the native population of the United States, is decidedly deficient, 24 points below the rate at which the native population of the country as a whole is reproduced (table 1).

Each type of population in New York State is reproduced at a slower rate than is the native population of the United States. The urban-population replacement rate for the State is 2 points below that for the country as a whole, while the rural rate for the State is 34 points below that of the country as a whole (table 1).

But the total rural population of the State is more than replacing its losses; its reproduction index is 120. The rural farm population is reproduced at the highest rate, 139; and the rural non-farm population is reproduced at the next highest rate, 113.

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[4] Stated in a letter to the author by Warren S. Thompson of the Scripps Foundation, Miami University, Oxford, Ohio. Dated February 12, 1940.

[5] The number of children 0 to 4 years of age has been increased for each instance in this study by the factor 1.05 to allow for the underenumeration of such children in the 1930 census. That there is an underenumeration is accepted by population students. Warren S. Thompson and P. K. Whelpton have indicated the adjustments necessary in a statement in *Population Trends in the United States*, page 263. The Committee on Population Problems, of the National Resources Board, has stated that this underenumeration should be allowed for in the 1930 census by the factor 1.05 for white population, and 1.11 for the negro population in the Northern States. See *Population Statistics, National Data*, National Resources Committee, October 1937, page 30, for this statement.

Negroes constitute 3 per cent of the New York State population and are concentrated largely in the cities. Since no separate analysis of the negro population is made here, and since their number can affect the indexes computed only very slightly, separate increases were not computed for them. All the increases were made by the same factor, 1.05.

TABLE 1. REPRODUCTION RATES PER GENERATION OF THE TOTAL NEW YORK POPULATION, WITH THE REPRODUCTION RATES OF THE TOTAL NATIVE WHITE POPULATION OF THE UNITED STATES, 1930

Type of population	Per cent of women 20–44 years of age residing in New York State	Index for	
		New York State*	Native white population of United States†
Total population	100.0	88	112
Urban:	87.0	84	86
New York City	59.5	80	...
Cities of 100,000 or more	11.6	88‡	76
Cities of 25,000 to 99,999	6.2	87	88
Cities of 10,000 to 24,999	5.4	98	97
Cities of 2,500 to 9,999§	4.3	...	104
Rural, total	13.0	120	154
Rural farm	3.7	139	169
Rural non-farm	9.3	113	137

*The indexes for New York State given in this table are slightly higher than similar indexes computed by Bernard D. Karpinos and presented in the *American Journal of Sociology*, vol. 43, no. 2, p. 251 ff, Sept. 1938, and by the Scripps Foundation for Research in Population Problems presented in *Population Index*, p. 268, Oct. 1938. The differences are due to slightly different methods employed and to assumptions followed. The method followed here was that used by the Committee on Population Problems of the National Resources Committee.

†The problems of changing population, p. 134. National Resources Committee, United States Government. May, 1938.

‡Does not include New York City.

§Not computed. Data not available.

The urban population is not replacing its losses. The natural rate of increase for the urban population is only 84, or 16 points below the replacement rate required to maintain this population.

New York City has the low rate of reproduction of 80, while the six other cities of 100,000 or more inhabitants have a rate of 88. Other types of cities of 10,000 or more are all reproducing at rates below 100.

This characteristic of New York urban population to reproduce at a rate below replacement is also true of the urban population of the United States; in fact the reproduction rates for the cities of New York State are not widely different from rates for cities of similar size in other States.

In as much as 87 per cent of the women 20 to 44 years of age in New York State reside in urban areas, the urban type of population influences the natural increase of the State most significantly. When compared with the rural population, which includes but 13 per cent of the women 20 to 44 years of age, and has a natural-increase index of 120, the urban is about four times as important as the rural population in determining the total natural increase. New York City, which includes 59.5 per cent of the women 20 to 44 years of age, and has a reproduction rate of 80, is more than three times as important as the rural population in its influence on the natural reproductive increase of the State. Even though the rural reproduction rate is higher than the urban rate, it cannot make up for the urban deficits in natural reproduction because the rural population includes such a low percentage of women aged 20 to 44.

The rural farm population, though having a natural-increase index of 139, is not as significant in its influence on the rate of natural increase of the State as is the rural non-farm population (index 113), for the number o

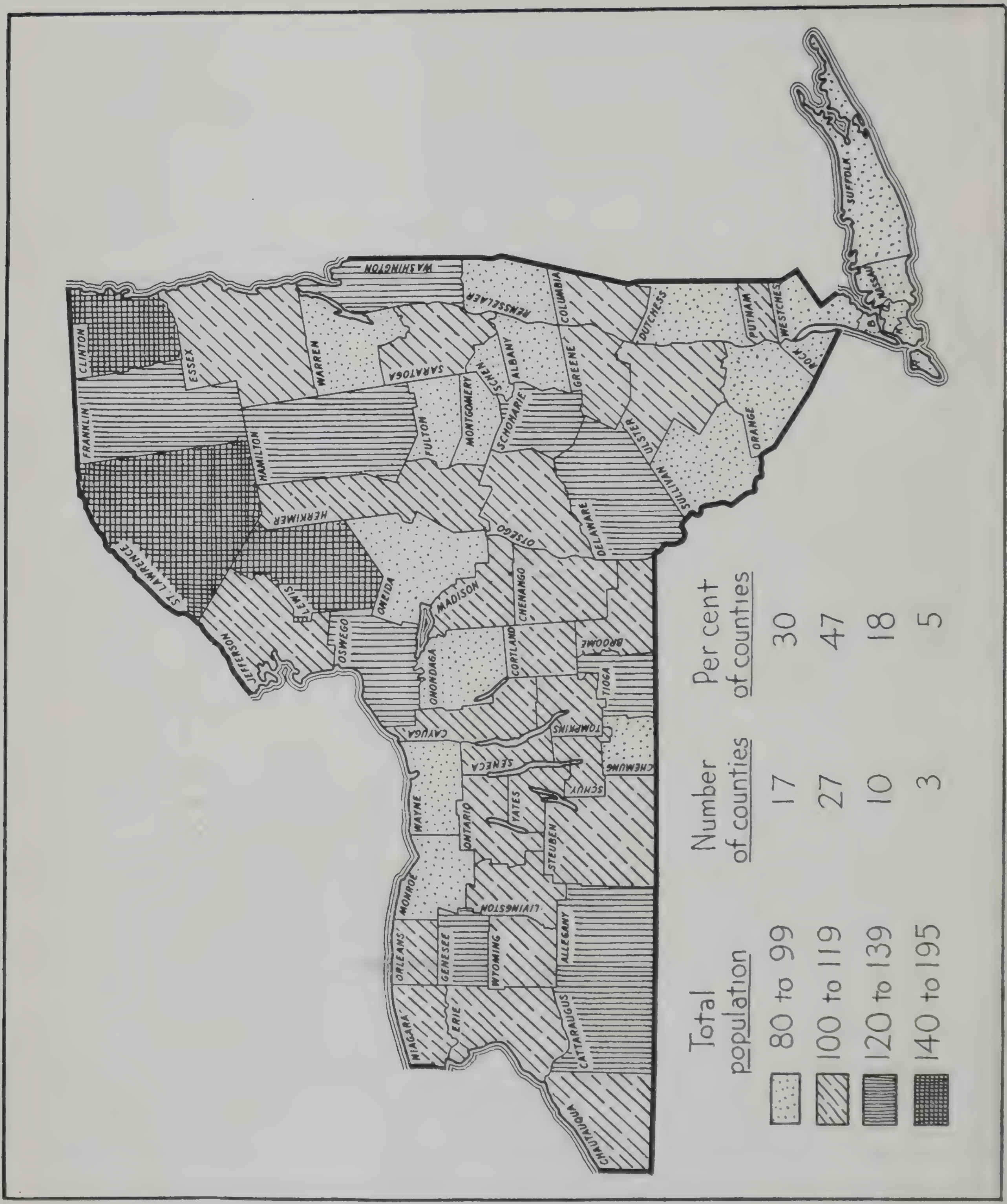

FIGURE 1. INDEX OF NATURAL INCREASE OF THE TOTAL POPULATION OF EACH COUNTY, 1930

The index of natural increase is the actual number of children less than 5 years of age per 1000 women 20 to 44 years of age, divided by the number of children per 1000 women 20 to 44 years of age required to maintain the population at its present size, assuming no migration in or out of the area

women 20 to 44 years of age in rural non-farm[6] population is about three times as large as the number in the farm population.

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[6] The rural non-farm population consists of those persons, living outside of cities and other incorporated places of more than 2500 inhabitants, who do not reside on farms. They include four main classes of inhabitants: 1, residents in incorporated hamlets and villages of less than 2500 persons; 2, residents in unincorporated hamlets and villages; 3, residents in unincorporated suburban districts outside city limits; 4, residents in the open country but not on farms.

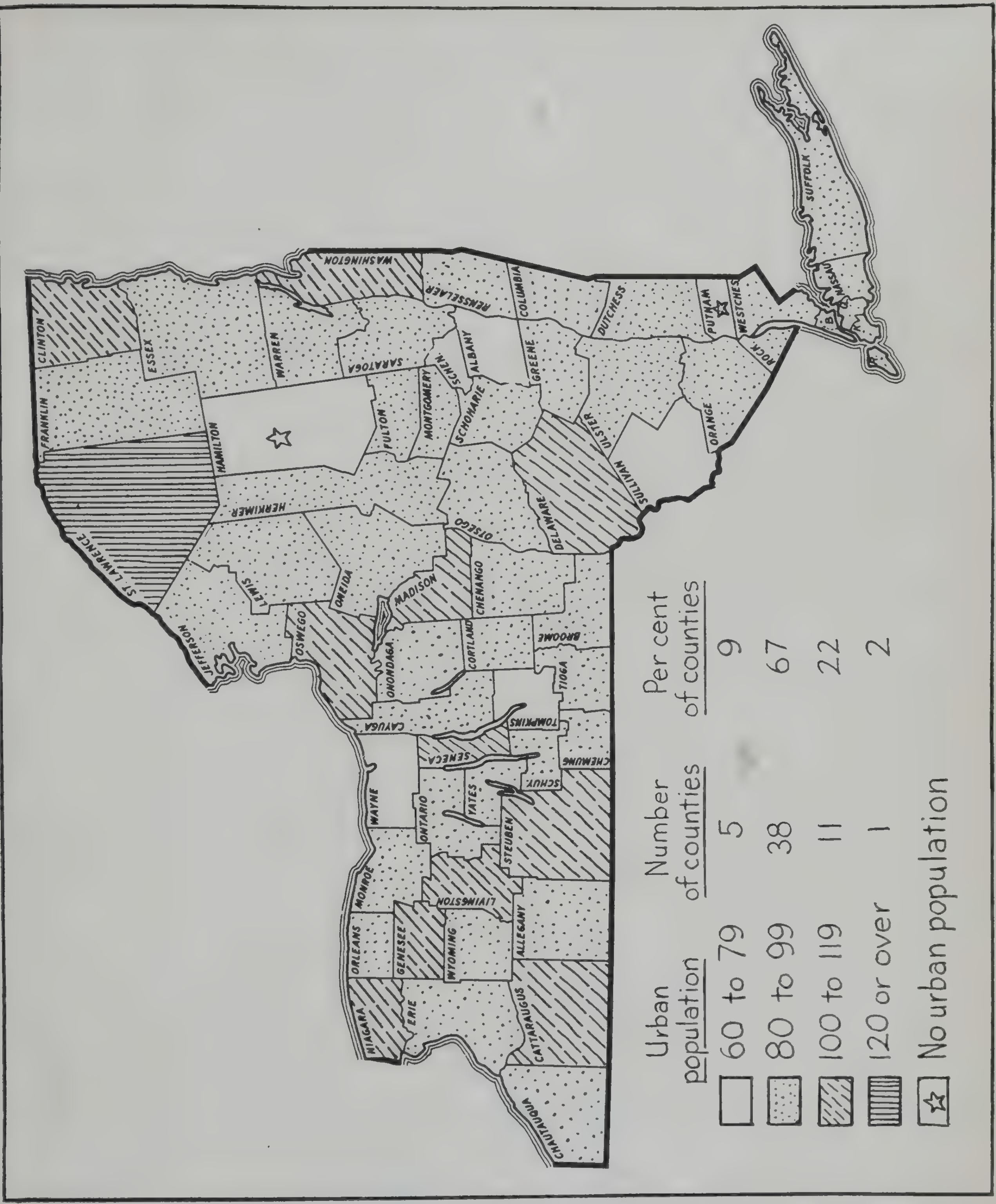

Figure 2. index of natural increase of the urban population in each county, 1930

NATURAL INCREASE BY COUNTIES

Total population. Of the 57 counties of the State, 17 (not including the 5 that compose New York City) have natural-increase indexes of between 80 and 99. Their population losses are not, therefore, being replaced by natural increase. They include a large urban population and must depend upon migration in addition to natural increase for their population maintenance. Most of them are near New York City or in the Great L (Mohawk-Hudson) Valley (figure 1).

Twenty-seven of the counties, nearly one-half, have indexes of 100 to 119. This means that the total population in them is slightly more than replacing its losses. These counties are predominantly rural in composition or include foreign-born populations that are still reproducing at a high rate (figure 1).

Thirteen of the counties, one of each four, have indexes of 120 to 159. They are all rural counties, predominantly farming, and are in both the Southern Tier and the northern mountain area. From these counties, the excess population moves into the counties with low reproduction rates, and this is a chief reason why the latter do not actually decline in numbers.

Urban population by counties. The urban population (persons residing in cities and incorporated places of 2500 or more inhabitants) has indexes of less than 100 in 43 of the 55 counties that include such population. Thus, in four of each five counties the urban population cannot maintain itself except as migration to the cities takes place. In five of the 43 counties the index of natural increase for the urban population is less than 80, indicating that natural increase is deficient for replacement by more than one-fifth (figure 2).

This is at a natural rate below that of New York City. Two of these, Albany and Schenectady, include large cities and are metropolitan areas. But Sullivan, Tompkins, and Wayne are, in the main, rural counties. Urban natural reproduction in Tompkins County may be low because of the presence in Ithaca of a large number of unmarried women 20 to 44 years of age, employed, as teachers, clerical workers, and secretaries, in the educational institutions. Sullivan County has less than 7000 urban residents. Wayne has about 15,000 urban dwellers, but is predominantly a farm county. Perhaps the low natural-reproduction rate of the urban women is accounted for by the presence in the urban areas of a large number of unmarried farm women who have migrated to these centers for work.

The 12 counties in which the urban population has indexes of natural increase of 100 or more contain few cities of large size. They are predominantly rural counties or else comprise a fairly high percentage of foreign-born persons. Seven of these counties have indexes just slightly above 100; thus their urban populations are not reproduced in any signicant excess. One county, St. Lawrence, has an index of urban natural increase of 120. This is the highest county index for urban population in the State. It is explained by the presence in the urban population of a large percentage of French-Canadian Catholics (figure 2).

Total rural population by counties. The total rural population is maintaining itself in all but three of the counties of the State, Suffolk, Westchester, and Dutchess. In Suffolk and Westchester, the very large rural non-farm population, relative to the rural farm population, depresses the index for the total rural population; the rural non-farm population has in both counties indexes of less than 100.

In Westchester, the farm population has an index of only 75, and the rural non-farm population, an index of 96. Westchester has little farm population within its borders. There are only 591 women 20 to 44 years of age on farms in the county, so that this index of reproduction is not an important component of the total state index (figure 3).

In 19 counties, the rural population shows an increase of less than 20 per cent, but in the other 35 counties the increase is 20 to 82 per cent. Clinton County, in the northeastern corner of the State, has the highest index, 182. Of the 35 counties with increases of more than 20 per cent, 26 have increases of 20 to 39 per cent.

The total rural-population increase in a given county is influenced, of course, by the proportions comprising farmers and non-farmers. In most of the counties that show only slight rural increases, the rural population is composed mainly of non-farmers, while in those that show large rural increases the population is largely farmers.

Rural farm population by counties. The rural farm population increases at the highest natural rate. For the whole State the rate of natural increase of the farm population is 139.

Two counties, Westchester and Rockland, show natural increases in the farm population that are smaller than replacement requirements. But neither of the two counties has a large enough farm population to be of importance in the total state situation. They are counties that are suburban to New York City and include primarily urban and rural non-farm residents (figure 4).

Of the 55 counties, 53 have indexes of natural increase in the farm population that are equal to or greater than that required for replacement. Of these, 32 increase at a rate of 40 to 95 per cent per generation. These counties with high natural increases in the farm population are mostly in the northern part of the State and along the southern border. The counties that include the largest cities, do not show as high natural rates of increase in the farm population as do those with no cities or with small ones (figure 4).

Rural non-farm population. The rural non-farm population of the whole State shows a natural increase of 13 per cent in excess of that required for replacement.

In four counties, Montgomery, Dutchess, Westchester, and Suffolk, the natural rate of increase is less than 100, while in Seneca County the index is only 65, or 35 per cent below replacement. In Dutchess, Westchester, and Suffolk, the index is influenced by New York City, while in Montgomery it is undoubtedly influenced by Albany and Schenectady. Seneca, however, is a distinctly rural county. It does not have a large non-farm population (figure 5).

In 30 counties, the rural non-farm population is increasing just in excess of the need for replacement. These counties are distributed generally throughout the State.

The 22 counties which show rates of increase of 20 per cent or more per generation are also generally distributed, but those with very high rates of increase are in the northern area (figure 5).

In six of the counties the natural rate of increase is 40 to 72 per cent in excess of that required for replacement. Four of these, Clinton, Lewis, Franklin, and St. Lawrence, are northern valley and mountain counties which have large French-Canadian Catholic populations. Broome County in the Southern Tier, has a high rate of natural increase in its non-farm population. This is due to the large number of foreign-born residents working in Binghamton, Endicott, and Johnson City who live in unincorporated village and rural territory. Genesee County, which is a farming county primarily, shows a high rate of natural increase for its non-farm population

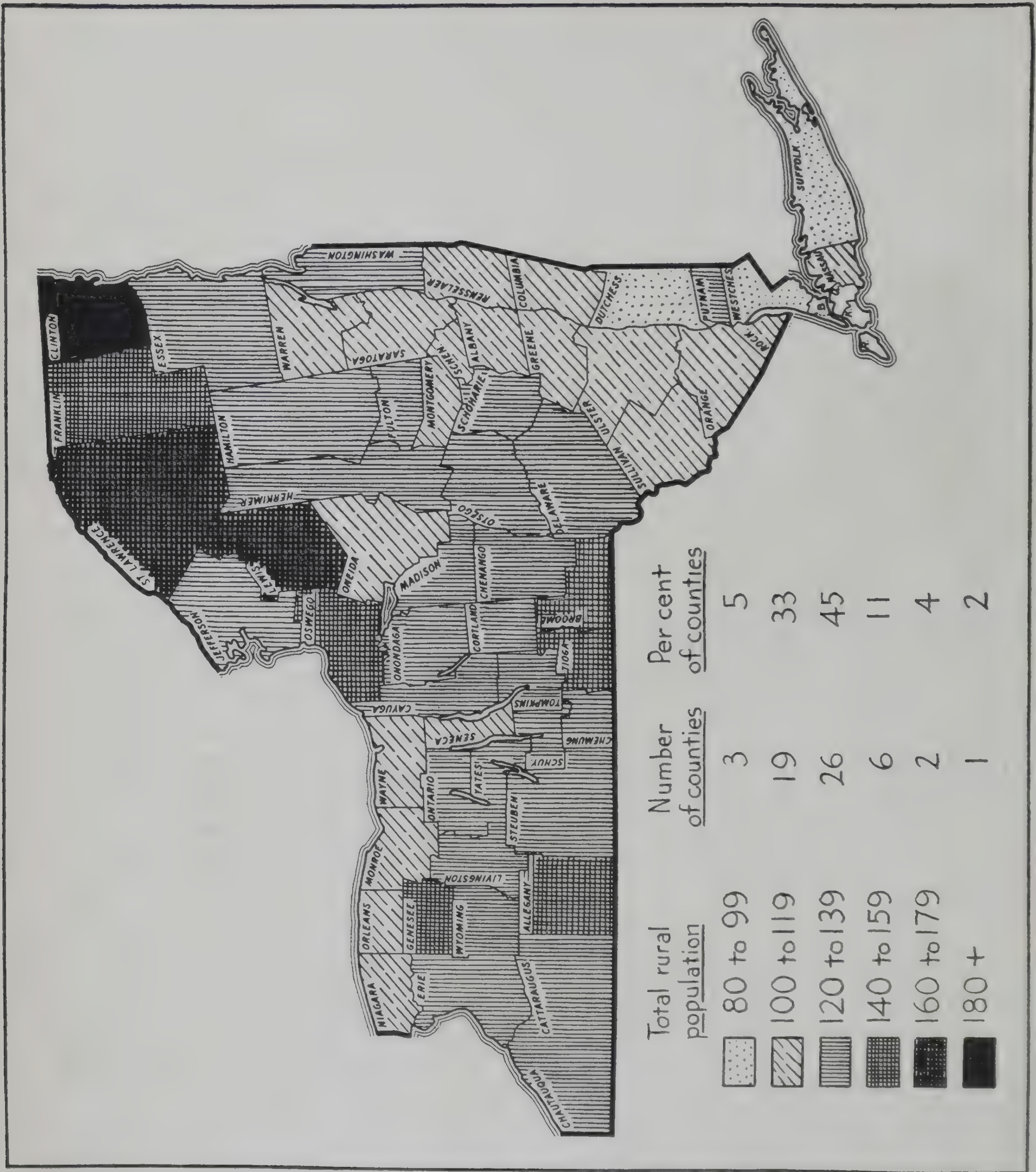

FIGURE 3. INDEX OF NATURAL INCREASE OF THE TOTAL RURAL POPULATION, 1930

as well as for its farm population. This is probably accounted for by the fairly large number of foreign-born inhabitants who reside in rural areas and work in the gypsum and other industrial enterprises.

In eight counties (Albany, Essex, Genesee, Greene, Hamilton, Rockland, Schenectady, and Sullivan), the index of natural increase of the rural non-farm population exceeds the index of natural increase of the farm population. But in only two, Hamilton and Rockland, is this excess as great as ten points, and in both of these the farm population is very small. In the other six, the indexes are almost the same.

On the other hand, in 38 counties the index of natural increase of the farm population exceeds that of the non-farm population by ten per cent.

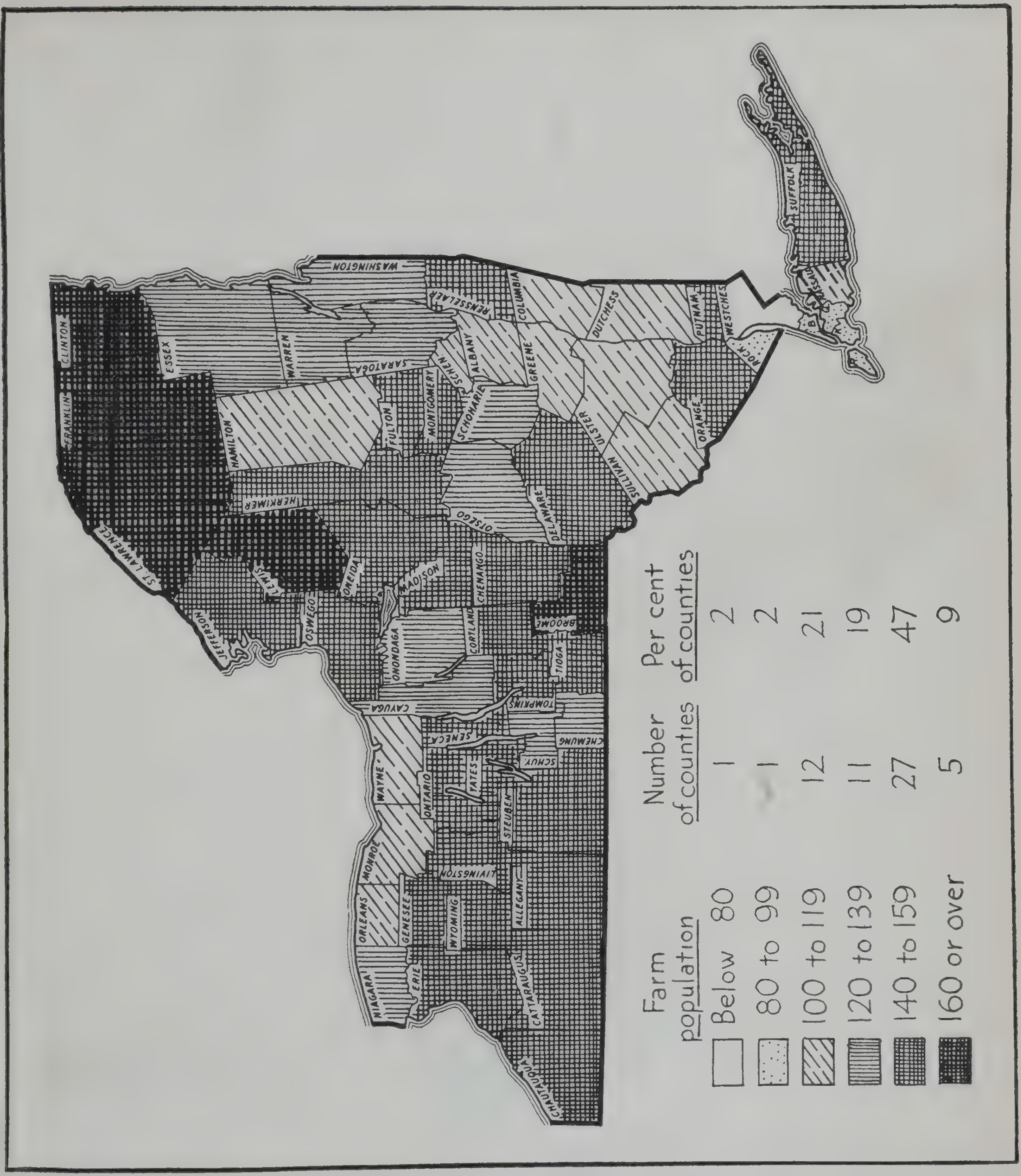

Figure 4. INDEX OF NATURAL INCREASE IN THE FARM POPULATION BY COUNTIES, 1930

The two extreme counties are Westchester and Clinton, the former with an index of 75 and the latter with an index of 195

while in 27 of these the excess was 20 or more per cent; thus it is apparent that the natural increase of rural population is influenced mainly by the large natural increase in the farm population.

NATURAL INCREASE BY GEOGRAPHIC AREAS

"Topographically, New York appears as a clear framework of hills separated by a Great L valley system. The latter is a belt stretching eastward from Lake Erie along Lake Ontario across the center of the State to the Hudson River, which, with its bordering lowlands, reaches south-

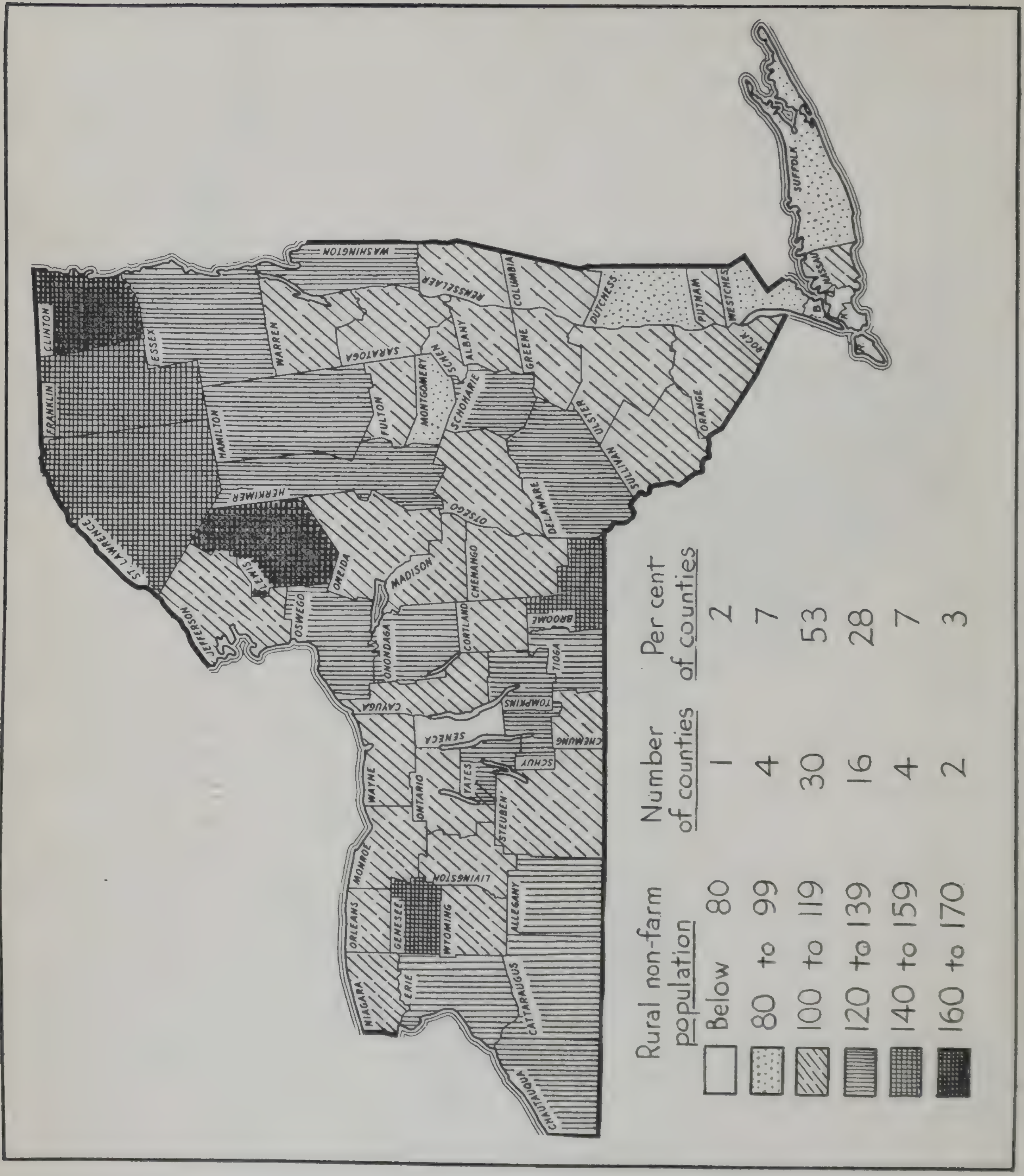

FIGURE 5. INDEX OF THE NATURAL INCREASE IN THE RURAL NON-FARM POPULATION, 1930

ward to the sea."[7] That this is true is clearly seen from figure 6, in which these areas are outlined. The same report further states that "the drift of population was not merely from country to city, it was from the rest of the State to the Valley system—where most of the big cities established themselves."[8] The location of the cities is indicated in figure 6.

New York State includes topographically, therefore, three major areas, the Great L (Mohawk and Hudson) Valley,[9] the Northern Valley and Mountain Counties,[10] and the Southern Tier Hill Counties.[11] A fourth area may be indicated, not because of geographic characteristics, but because of the influence of New York City upon it. This area includes the five counties suburban to New York City (Putnam, Rockland, Westchester, Nassau, and Suffolk), and is called herein the *New York City suburban area*. A sixth area may be termed the *Lower Hudson Area*.[12] This region includes six counties, two of which, Columbia and Dutchess, are geographically parts of the Great L Valley and four of which, Greene,

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[7] *From Report of the Commission on Housing and Regional Planning to Governor Alfred E. Smith, May 7, 1926*, p. 13.

[8] *From Report of the Commission on Housing and Regional Planning to Governor Alfred E. Smith, May 7, 1926*, p. 36.

TABLE 2. Index of Natural Increase in the Population of New York State, by Geographic Regions

Region	Total population	Urban	Total rural	Rural farm	Rural non-farm
New York City	80	80	...	...	...
Five counties suburban to New York City	92	86	102	123	101
Lower Hudson Area	97	80	108	118	104
Northern Valley and Mountain Counties:	127	105	146	157	138
5 counties with cities of 10,000 or more	125	103	147	159	138
5 counties without cities of 10,000 or more	132	113	144	152	138
Great L Valley (Mohawk and Hudson)	97	91	120	131	115
Southern Tier	111	93	135	147	126
8 counties with cities of 10,000 or more	108	94	135	148	127
8 counties without cities of 10,000 or more	122	90	134	145	124
Total State	88	84	120	139	113

TABLE 3. Percentage of the Total New York State Population and of the Women 20–44 Years of Age that Reside in the Various Areas of New York State

Area	Per cent total state population in area					Per cent women 20–44 years of age in area				
	Total	Urban	Total rural	Rural farm	Rural non-farm	Total	Urban	Total rural	Rural farm	Rural non-farm
New York City	55.1	55.1	0	0	0	59.6	59.5	0	0	0
Five counties suburban to New York City	8.4	5.0	3.4	0.2	3.2	8.4	5.2	3.2	0.1	3.1
Lower Hudson	3.3	1.5	1.8	0.6	1.4	2.8	1.5	1.4	0.4	1.0
Northern Valley and Mountain Area:	3.8	1.6	2.2	1.0	1.2	2.9	1.3	1.6	0.7	0.9
5 counties with cities of 10,000 or more	2.6	1.2	1.4	0.7	0.7	2.0	1.0	1.0	0.5	0.6
5 counties without cities of 10,000 or more	1.2	0.4	0.8	0.4	0.5	0.9	0.3	0.6	0.2	0.4
Great L Valley	22.7	17.2	5.6	2.1	3.4	20.8	16.5	4.3	1.4	2.9
Southern Tier	6.7	3.3	3.4	1.6	1.8	5.5	3.0	2.5	1.1	1.4
8 counties with cities of more than 10,000	5.0	2.9	2.1	0.9	1.1	4.2	2.7	1.5	0.6	0.9
8 counties without cities of 10,000 or more	1.7	0.4	1.3	0.7	0.7	1.3	0.3	1.0	0.5	0.5
Total State	100.0	83.6	16.4	5.6	10.8	100.0	87.0	13.0	3.7	9.3

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[9] The counties included here in the Great L Valley Area are: Erie, Niagara, Orleans, Genesee, Monroe, Livingston, Wayne, Ontario, Seneca, Cayuga, Onondaga, Oneida, Madison, Herkimer, Fulton, Montgomery, Saratoga, Schenectady, Albany, and Rensselaer.

[10] The counties included in the Northern Valley and Mountain Area are: Oswego, Jefferson, Lewis, St. Lawrence, Franklin, Clinton, Essex, Warren, Hamilton, and Washington.

[11] The counties included in the Southern Tier Hill Area are: Chautauqua, Cattaraugus, Wyoming, Allegany, Steuben, Yates, Schuyler, Chemung, Tioga, Tompkins, Cortland, Broome, Chenango, Otsego, Delaware, Schoharie.

[12] The counties of the Lower Hudson Area are: Columbia, Dutchess, Greene, Sullivan, Ulster, and Orange.

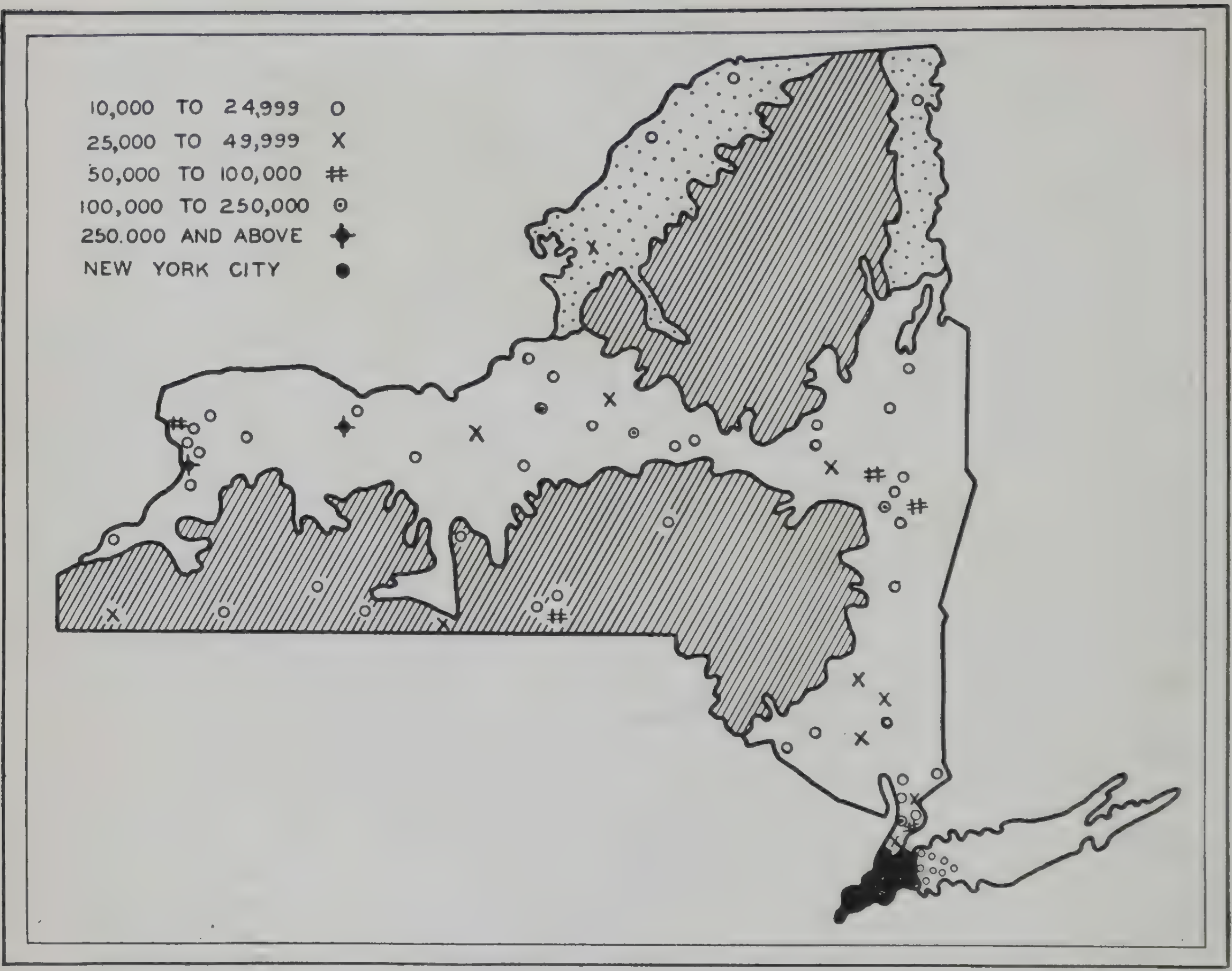


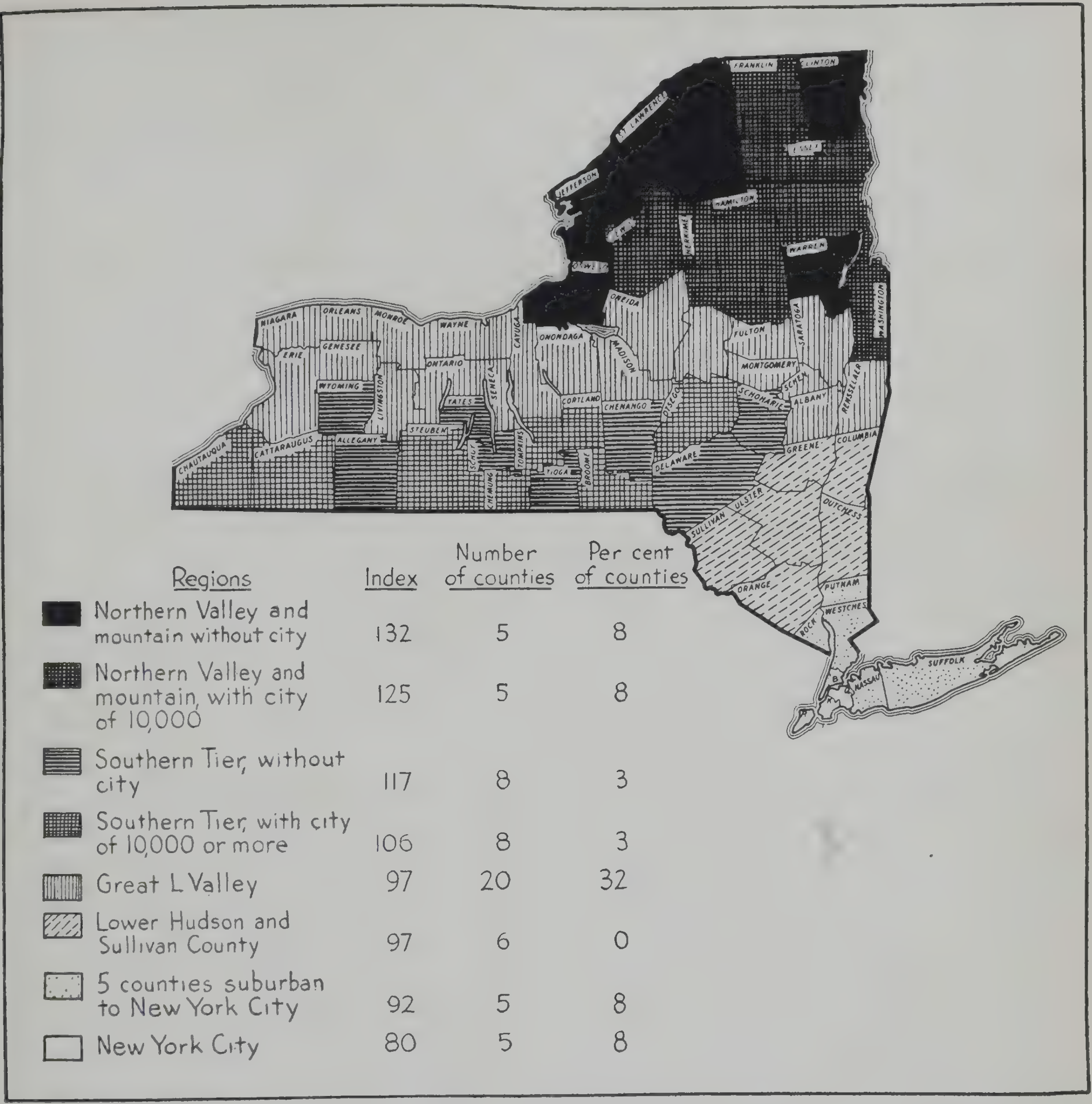
FIGURE 6. CHIEF TOPOGRAPHICAL AREAS OF NEW YORK STATE AND THE LOCATION OF CITIES OF 10,000 OR MORE INHABITANTS

The Great L (Mohawk and Hudson) Valley stretches across the center of the State from the west to the Hudson River and then south to the ocean. In this area are most of the large cities. The Northern Mountain and Valley Area and the Southern Tier Hill Area include only a few of the large cities of the State

Sullivan, Ulster and Orange are geographically parts of the Southern Tier. But these six Lower Hudson counties comprise a fairly homogeneous region of resorts and estates, and are therefore treated here as a separate area.

The Northern Valley and Mountain Area has higher indexes of natural population reproduction in each type of population than has any other area of the State. Its rural farm index, 157, is 18 per cent higher than that of the State as a whole, 139; it is 10 per cent higher than that of the Southern Tier, 147. And in the other types of population, rural non-farm, urban, and total, its indexes are 20 to 35 per cent higher than for the similar populations in the State as a whole, and 10 to 16 points higher than the indexes of the similar population in the Southern Tier (figure 7).

The Northern Valley and Mountain Area is predominantly rural, with only 5 cities of 10,000 or more inhabitants and one with a population of nearly 35,000. Likewise, it contains a considerable French-Canadian population, Catholic in religion, which has a high reproduction rate. These two factors explain the high reproduction indexes of the area. Even the urban population of this area is slightly above replacement requirements, which is not true of any of the other areas (figure 7).



Regions	Index	Number of counties	Per cent of counties
■ Northern Valley and mountain without city	132	5	8
▦ Northern Valley and mountain, with city of 10,000	125	5	8
▤ Southern Tier, without city	117	8	3
▦ Southern Tier, with city of 10,000 or more	106	8	3
▥ Great L Valley	97	20	32
▨ Lower Hudson and Sullivan County	97	6	0
⬚ 5 counties suburban to New York City	92	5	8
□ New York City	80	5	8

FIGURE 7. INDEX OF NATURAL INCREASE IN THE TOTAL POPULATION BY REGIONS, 1930

The Southern Tier ranks next among the areas in its natural replacement indexes. The total population is being reproduced at a rate slightly higher than replacement requirements, while the farm population exceeds the replacement requirements by 47 per cent. The urban population losses of the area are not being replaced (index 93) but the non-farm population exceeds replacement requirements by 26 per cent.

The Southern Tier is predominantly a hilly rural region. Eight of the 16 counties included herein as parts of the area, have no city with as many as 10,000 inhabitants. Of the counties with cities of 10,000 or more inhabitants, only Broome, Chemung, and Chautauqua have cities of more than 25,000 inhabitants. The other cities of more than 10,000 inhabitants, nine in all, have populations of between 10,000 and 25,000. Although the populations of these cities are below replacement requirements, the rural population does produce a considerable excess for its replacement, so that the total for the area is slightly above replacement requirements (table 2 and figure 7).

The Great L (Mohawk and Hudson) Valley Area is not replacing its population. The index of natural reproduction for the whole area is 97, or 3 per cent below replacement requirements. The farm and non-farm population of this area is above replacement, index 131 and 115, but the proportion of urban population in the area is so large that the excess natural reproduction of the rural population cannot make up for the deficient natural reproduction of the urban population.

The population of the Lower Hudson Area is being replaced at the same rate as that in the Great L Valley. The index of natural increase of the total population is 97. The index of natural increase of the urban population of this area is as low as the index of natural increase for New York City, 80. The total rural, rural farm, and rural non-farm populations, though increasing at a rate slightly higher than that necessary for replacement, show natural increases much smaller than those in the Southern Tier or in the Northern Valley and Mountain Area (table 2 and figure 7).

Likewise, the population of the five-county area suburban to New York City is not being replaced by natural reproduction. The index of natural increase for the area as a whole is 92, 8 per cent below requirements for replacement. The index of reproduction for the urban population is only 86. The total rural population losses of the area are barely being replaced, index 102. The rural non-farm population has an index of 101, while the farm population has an index of 123, or almost one-fourth more than is needed for its own replacement (table 2).

There are, therefore, three areas, the Great L Valley, the Lower Hudson Area, and the New York City Suburban Area, in which the population is below replacement requirements. These together with New York City, include 89.5 per cent of the State's population and 91.6 per cent of the women 20 to 44 years of age. Their greater influence upon the natural increase in the State's population is obvious. Even though the populations of the Northern Valley and Mountain Area and the Southern Tier are above replacement requirements, since they include but 10.5 per cent of the State's population and only 8.4 per cent of the women 20 to 44 years of age, the rate of natural increase for the State must be below that required to maintain the population.

SOCIAL IMPLICATIONS

Several important social implications result from these facts about the natural increase in the counties, the areas, and the State as a whole.

Since losses in New York population are not replaced by natural methods, if the population remains at its present size, not to suggest increase, there will continue to be considerable migration to it from without and much migration between areas within. It will continue to be an area of absorption for excess population produced elsewhere. In 1930, 37.8 per cent, or almost 4 of each 10 of its inhabitants were born outside the State.[13] If natural increase continues at its present rate, this proportion must increase.

Mobility within the State is also likely to increase. There will be a continued flow of population from the areas where excess natural increase takes place, the Northern Mountain and the Southern Tier Hill Areas, to the cities of underproduction within these areas and to the Great L Valley Area, the Lower Hudson Area, the New York City Suburban Area, and New York City itself.

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[13] Movement of population to and from New York State. By W. A. Anderson. Cornell Univ. Agr. Exp. Sta. Bul. 591. 1934.

In a State like New York, which is so predominantly urban, this migration, both from without and within, is likely to show a greater proportion of women than of men moving into the areas of population underproduction. As of 1930, only 97 men to every 100 women came to New York, while, of those leaving New York State for other areas, there were 103 men to every 100 women.[14] Likewise the rural area of the State cannot absorb the women in economically productive activities as effectively as it can the men, so that larger proportions of women than of men move to the urban regions. But the excess population both of men and women, which seems to be about seven of every ten of the young people reared in the rural areas of the State, migrate into these urban regions of population underproduction.

The population moving into New York State is chiefly adult. That which is native is already reared and educated at the expense of the areas of production. Such populations enter the State at their productive period and thus the State benefits. But the foreign and the negro population must be assimilated into the new cultural situation and this demands programs of citizenship training.

The migration of excess population from the rural areas of population overproduction to the urban areas of underproduction means that the rural areas bear the cost of rearing and educating these persons for their productive use by the urban regions. Adjustment of these costs must be made if the rural areas are to maintain adequate institutions for the proper training of the youths they rear for the cities.

Institutions and organizations in the rural areas, especially those of a voluntary type such as the church, suffer particularly from this migration, for the young people migrate just when they could begin to contribute support and leadership. Such institutions and organizations show abnormally high proportions of children and older people in their membership.

From the urban point of view, there is also the problem of attracting these migrants from the rural areas to constructive community-building agencies.

Another question of social importance raised by these facts is whether the excess population is being produced by those who are least fitted to bear and rear children. This question requires special study, but it has been suggested that, at least from an economic and perhaps from a social and educational point of view, the population groups best fitted to bear and rear larger numbers of children are not doing so, while those least fitted reproduce at the higher rates.

There is likewise the problem of the effect of higher rates of natural reproduction in an area or by a class upon levels of living. Are the urban classes reproducing at low rates in order to maintain standards of living, at least in the material sense? Does natural reproduction at high rates mean the sacrifice of standards of living? These questions are not answered by findings of this study, but these findings do raise the questions.

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[14] Movement of population to and from New York State. By W. A. Anderson. Cornell Univ. Agr. Exp. Sta. Bul. 591. (Reference on p. 33.) 1934.

APPENDIX

TABLE 4. INDEX OF NATURAL INCREASE, WITH THE FIGURES FOR COMPUTATION, FOR THE TOTAL POPULATION OF NEW YORK STATE BY COUNTIES, 1930

County	Number of children 0–4 years of age*	Number of women 20–44 years of age	Number of children 0–4 years of age per 1000 women aged 20–44	Index of natural increase (ratio of children to women, divided by 442)
Albany	16,274	43,950	370	84
Allegany	3,575	6,122	584	132
Bronx	109,124	296,974	367	83
Broome	13,771	28,886	477	108
Cattaraugus	6,726	12,521	537	121
Cayuga	4,927	10,730	459	104
Cheutauqua	10,802	22,784	474	107
Chemung	6,012	14,061	428	98
Chenango	2,732	5,581	490	111
Clinton	4,775	7,134	669	151
Columbia	3,029	6,740	449	102
Cortland	2,510	5,519	455	103
Delaware	3,698	6,539	566	128
Dutchess	7,901	19,457	406	92
Erie	69,195	154,804	447	101
Essex	3,110	5,928	525	119
Franklin	4,415	7,914	558	126
Fulton	3,423	8,330	411	93
Genesee	4,212	7,301	577	130
Greene	1,925	4,075	472	107
Hamilton	361	624	579	131
Herkimer	5,039	11,007	458	104
Jefferson	7,006	14,389	487	110
Kings	224,508	558,083	402	91
Lewis	2,360	3,504	674	152
Livingston	3,209	6,147	522	118
Madison	3,269	6,289	520	118
Monroe	33,347	87,003	383	87
Montgomery	4,559	11,106	410	93
Nassau	28,368	66,552	426	96
New York	119,501	449,163	266	60
Niagara	13,890	28,225	492	111
Oneida	16,197	36,863	439	99
Onondaga	24,560	57,041	431	97
Ontario	4,532	9,220	492	111
Orange	9,979	23,494	425	96
Orleans	2,153	4,666	461	104
Oswego	6,092	11,221	543	123
Otsego	3,581	7,687	466	105
Putnam	1,218	2,316	526	119
Queens	95,055	248,544	382	86
Rensselaer	8,673	23,365	371	84
Richmond	14,192	30,455	466	105
Rockland	4,818	10,938	440	99
St. Lawrence	9,085	14,581	623	141
Saratoga	5,028	10,994	457	103
Schenectady	9,225	25,142	367	83
Schoharie	1,603	2,929	547	124
Schuyler	1,019	1,942	525	119
Seneca	1,810	3,819	474	107
Steuben	7,290	13,953	522	118
Suffolk	12,993	30,304	429	97
Sullivan	2,608	6,073	429	97
Tioga	2,162	3,959	546	123
Tompkins	3,376	7,419	455	102
Ulster	6,274	13,923	451	102
Warren	2,672	6,473	413	93
Washington	4,003	7,500	534	121
Wayne	3,560	8,722	408	92
Westchester	43,793	114,265	383	87
Wyoming	2,312	4,491	515	116
Yates	1,344	2,650	507	115
Total	1,038,760	2,662,391	390	88

*The United States Census for 1930, volume 3, number 2 (*Population, Composition and Characteristics*), gives the number of children 0 to 4 years of age by counties, etc. These figures were increased by the factor 1.05 to allow for underenumeration, as previously indicated on page 4.

TABLE 5. INDEX OF NATURAL INCREASE, WITH THE FIGURES FOR COMPUTATION, FOR THE URBAN POPULATION OF NEW YORK STATE BY COUNTIES, 1930

County	Number of children 0–4 years of age*	Number of women 20–44 years of age	Number of children 0–4 years of age per 1000 women aged 20–44	Index of natural increase (ratio of children to women, divided by 443)
Albany	12,746	36,565	349	79
Allegany	477	1,114	428	97
Bronx	109,124	296,974	367	83
Broome	9,192	22,079	416	94
Cattaraugus	3,050	6,390	477	108
Cayuga	2,756	6,660	414	93
Chautauqua	6,570	15,385	427	96
Chemung	3,900	10,157	384	87
Chenango	604	1,660	364	82
Clinton	1,254	2,717	462	104
Columbia	898	2,227	403	91
Cortland	1,313	3,498	375	85
Delaware	291	609	478	108
Dutchess	4,479	10,963	409	92
Erie	58,962	137,109	430	97
Essex	754	1,830	412	93
Franklin	1,748	4,081	428	97
Fulton	2,373	6,444	368	83
Genesee	1,979	3,937	503	114
Greene	373	894	417	94
Hamilton†				
Herkimer	3,108	7,718	403	91
Jefferson	2,989	7,203	415	94
Kings	224,508	558,083	402	91
Lewis	267	611	437	99
Livingston	689	1,404	491	110
Madison	1,234	2,600	475	107
Monroe	27,481	75,190	365	82
Montgomery	2,975	7,899	377	85
Nassau	12,081	31,479	384	87
New York	119,501	449,163	266	60
Niagara	11,277	23,234	485	110
Oneida	11,897	28,336	420	95
Onondaga	18,444	46,145	400	90
Ontario	1,908	4,457	428	97
Orange	5,147	14,180	363	82
Orleans	802	1,960	409	92
Oswego	2,923	6,188	472	107
Otsego	1,112	3,123	356	80
Putnam				
Queens	95,055	248,544	382	86
Rensselaer	6,199	18,152	356	80
Richmond	14,192	30,455	466	105
Rockland	1,779	4,226	421	95
St. Lawrence	3,651	6,882	531	120
Saratoga	2,638	6,298	419	95
Schenectady	7,375	21,020	351	79
Schoharie	186	482	386	87
Schuyler	215	535	402	91
Seneca	836	1,711	489	110
Steuben	3,336	7,328	455	103
Suffolk	2,518	6,082	414	94
Sullivan	499	1,463	341	77
Tioga	800	1,820	440	99
Tompkins	1,481	4,239	349	79
Ulster	2,676	6,886	389	88
Warren	1,372	3,840	357	81
Washington	1,719	3,451	498	112
Wayne	842	3,173	265	60
Westchester	36,779	97,438	377	85
Wyoming	517	1,455	355	80
Yates	350	975	359	81
Total	856,197	2,316,721	370	84

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*The United States Census for 1930, volume 3, number 2 (*Population, Composition and Characteristics*), gives the number of children 0 to 4 years of age by counties, etc. These figures were increased by the factor 1.05 to allow for underenumeration as previously indicated on page 4.

†No urban population.

TABLE 6. INDEX OF NATURAL INCREASE, WITH THE FIGURES FOR COMPUTATION, FOR THE TOTAL RURAL POPULATION OF NEW YORK STATE BY COUNTIES, 1930

County	Number of children 0–4 years of age*	Number of women 20–44 years of age	Number of children 0–4 years of age per 1000 women aged 20–44	Index of natural increase (ratio of children to women, divided by 439)
Albany	3,528	7,385	478	109
Allegany	3,099	5,008	619	141
Bronx†				
Broome	4,579	6,807	673	153
Cattaraugus	3,676	6,131	600	137
Cayuga	2,170	4,070	533	121
Chautauqua	4,233	7,399	572	130
Chemung	2,113	3,904	541	123
Chenango	2,128	3,921	543	124
Clinton	3,522	4,417	797	182
Columbia	2,132	4,513	472	108
Cortland	1,197	2,021	592	135
Delaware	3,407	5,930	575	131
Dutchess	3,422	8,494	403	92
Erie	10,233	17,695	578	132
Essex	2,356	4,098	575	131
Franklin	2,667	3,833	696	159
Fulton	1,050	1,886	557	127
Genesee	2,232	3,364	663	151
Greene	1,552	3,181	488	111
Hamilton	361	624	579	132
Herkimer	1,931	3,289	587	134
Jefferson	4,016	7,186	559	127
Kings†				
Lewis	2,093	2,893	723	165
Livingston	2,520	4,743	531	121
Madison	2,035	3,689	552	126
Monroe	5,866	11,813	497	113
Montgomery	1,584	3,207	494	113
Nassau	16,287	35,073	464	106
New York				
Niagara	2,613	4,991	524	119
Oneida	4,301	8,527	504	115
Onondaga	6,115	10,896	561	128
Ontario	2,624	4,763	551	126
Orange	4,832	9,314	519	118
Orleans	1,350	2,706	499	114
Oswego	3,169	5,033	630	144
Otsego	2,469	4,564	541	123
Putnam	1,218	2,316	526	120
Queens†				
Rensselaer	2,474	5,213	475	108
Richmond†				
Rockland	3,040	6,712	453	103
St. Lawrence	5,434	7,699	706	161
Saratoga	2,391	4,696	509	116
Schenectady	1,850	4,122	449	102
Schoharie	1,418	2,447	579	132
Schuyler	803	1,407	571	130
Seneca	974	2,108	462	105
Steuben	3,954	6,625	597	136
Suffolk	10,475	24,222	432	98
Sullivan	2,109	4,610	457	104
Tioga	1,362	2,139	637	145
Tompkins	1,895	3,180	596	136
Ulster	3,597	7,037	511	116
Warren	1,300	2,633	494	113
Washington	2,284	4,049	564	128
Wayne	2,717	5,549	490	112
Westchester	7,014	16,827	417	95
Wyoming	1,796	3,036	592	135
Yates	994	1,675	593	135
Total	182,562	345,670	528	120

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*The United States Census for 1930, volume 3, number 2 (*Population, Composition and Characteristics*), gives the number of children 0 to 4 years of age by counties, etc. These figures were increased by the factor 1.05 to allow for underenumeration as previously indicated on page 4.

†No rural population.

TABLE 7. INDEX OF NATURAL INCREASE, WITH THE FIGURES FOR COMPUTATION, FOR THE RURAL FARM POPULATION OF NEW YORK STATE BY COUNTIES, 1930

County	Number of children 0–4 years of age*	Number of women 20–44 years of age	Number of children 0–4 years of age per 1000 women aged 20–44	Index of natural increase (ratio of children to women, divided by 439)
Albany	627	1,394	450	103
Allegany	1,413	2,045	691	157
Bronx†				
Broome	1,281	1,775	722	164
Cattaraugus	1,597	2,414	662	151
Cayuga	1,234	2,125	581	132
Chautauqua	2,192	3,543	619	141
Chemung	580	956	607	138
Chanango	1,147	1,868	614	140
Clinton	1,586	1,853	856	195
Columbia	697	1,350	516	118
Cortland	793	1,213	654	149
Delaware	1,607	2,596	619	141
Dutchess	896	1,738	516	117
Erie	2,399	3,872	620	141
Essex	576	1,033	558	127
Franklin	1,321	1,748	756	172
Fulton	487	751	648	148
Genesee	1,043	1,604	650	148
Greene	498	1,081	461	105
Hamilton	50	97	515	117
Herkimer	993	1,574	631	144
Jefferson	1,777	2,890	615	140
Kings†				
Lewis	1,133	1,528	741	169
Livingston	1,004	1,495	672	153
Madison	1,092	1,709	639	146
Monroe	1,532	2,983	514	117
Montgomery	752	1,201	626	143
Nassau	320	659	486	111
New York†				
Niagara	1,431	2,636	543	124
Oneida	1,635	2,656	616	140
Onondaga	1,707	2,971	575	131
Ontario	1,388	2,235	621	141
Orange	1,406	2,279	617	141
Orleans	757	1,464	517	118
Oswego	1,802	2,595	694	158
Otsego	1,240	2,110	588	134
Putnam	222	346	642	146
Queens†				
Rensselaer	677	1,435	642	146
Richmond†				
Rockland	87	237	367	84
St. Lawrence	2,978	4,179	713	162
Saratoga	798	1,466	544	124
Schenectady	195	438	445	101
Schoharie	767	1,316	583	133
Schuyler	418	725	577	131
Seneca	631	979	645	147
Steuben	2,118	3,103	683	156
Suffolk	1,083	1,707	634	144
Sullivan	776	1,772	438	100
Tioga	811	1,216	667	152
Tompkins	896	1,365	656	149
Ulster	1,255	2,437	515	117
Warren	298	556	536	122
Washington	983	1,698	579	132
Wayne	1,457	2,844	512	117
Westchester	195	591	330	75
Wyoming	1,036	1,536	674	154
Yates	655	1,056	620	141
Total	60,327	99,043	609	139

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*The United States Census for 1930, volume 3, number 2, (*Population, Composition and Characteristics*), gives the number of children 0 to 4 years of age by counties, etc. These figures were increased by the factor 1.05 to allow for underenumeration as previously indicated on page 4.

†No rural farm population.

TABLE 8. INDEX OF NATURAL INCREASE, WITH THE FIGURES FOR COMPUTATION, FOR THE RURAL NON-FARM POPULATION OF NEW YORK STATE BY COUNTIES, 1930

County	Number of children 0–4 years of age*	Number of women 20–44 years of age	Number of children 0–4 years of age per 1000 women aged 20–44	Index of natural increase (ratio of children to women, divided by 439)
Albany	2,901	5,991	484	110
Allegany	1,685	2,963	569	130
Bronx†				
Broome	3,298	5,032	655	149
Cattaraugus	2,079	3,717	559	127
Cayuga	937	1,945	482	110
Chautauqua	2,040	3,856	529	121
Chemung	1,533	2,948	520	118
Chenango	982	2,053	478	109
Clinton	1,936	2,564	755	172
Columbia	1,434	3,163	453	103
Cortland	404	808	500	114
Delaware	1,801	3,334	540	123
Dutchess	2,526	6,756	374	85
Erie	7,834	13,823	567	129
Essex	1,780	3,065	581	132
Franklin	1,346	2,085	646	147
Fulton	563	1,135	496	113
Genesee	1,190	1,760	676	154
Greene	1,054	2,100	502	114
Hamilton	311	527	590	134
Herkimer	938	1,715	547	125
Jefferson	2,240	4,296	521	119
Kings†				
Lewis	961	1,365	704	160
Livingston	1,516	3,248	467	106
Madison	943	1,980	476	108
Monroe	4,334	8,830	491	112
Montgomery	833	2,006	415	95
Nassau	15,966	34,414	464	106
New York†				
Niagara	1,182	2,355	502	114
Oneida	2,666	5,871	454	103
Onondaga	4,408	7,925	556	127
Ontario	1,236	2,528	489	111
Orange	3,426	7,035	487	111
Orleans	593	1,242	477	109
Oswego	1,367	2,438	561	128
Otsego	1,229	2,454	501	114
Putnam	996	1,970	506	115
Queens†				
Rensselaer	1,797	3,778	476	108
Richmond†				
Rockland	2,953	6,475	456	104
St. Lawrence	2,456	3,520	698	159
Saratoga	1,593	3,230	493	112
Schenectady	1,655	3,684	449	102
Schoharie	651	1,131	576	131
Schuyler	385	682	565	129
Seneca	343	1,129	304	69
Steuben	1,836	3,522	521	119
Suffolk	9,392	22,515	417	95
Sullivan	1,334	2,838	470	107
Tioga	551	923	597	136
Tompkins	999	1,815	550	125
Ulster	2,343	4,600	509	116
Warren	1,002	2,077	482	110
Washington	1,301	2,351	553	126
Wayne	1,260	2,705	466	106
Westchester	6,819	16,236	420	96
Wyoming	759	1,500	506	115
Yates	339	619	548	125
Total	122,236	246,627	496	113

*The United States Census for 1930, volume 3, number 2 (*Population, Composition and Characteristics*), gives the number of children 0 to 4 years of age by counties, etc. These figures were increased by the factor 1.05 to allow for underenumeration as previously indicated on page 4.

†No rural farm population.

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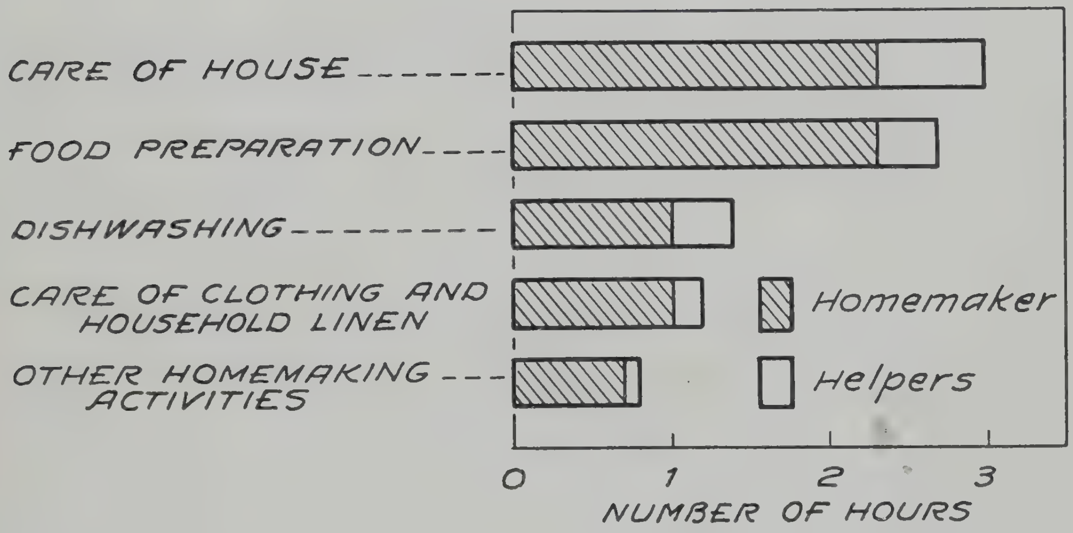
Bulletin 734

June 1940

Use of Time in Its Relation to Home Management

Jean Warren



TIME USED BY HOMEMAKERS AND HELPERS FOR VARIOUS HOMEMAKING ACTIVITIES ON THE WEEKDAY PRECEDING THE INTERVIEW

Contribution from the Laboratories in Home Economics
Cornell University Agricultural Experiment Station
Ithaca, New York

Received for publication September 22, 1939

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USE OF TIME
IN ITS RELATION TO HOME MANAGEMENT[1]

JEAN WARREN

Use of time has been commonly recognized as one of the outstanding problems connected with home management, and a number of studies have been made of the use of time by farm, village, and city homemakers. However, since little information is available as yet on causes of variation in the amount of time spent on certain tasks, one of the main purposes of the present study was to analyze various factors which might affect the homemaker's use of time, in addition to composition of the household and help received, which were already known to be important.

Another aim of the present study was to find some measure which could be used in comparing the work loads in different households, similar to the productive-man-work unit that has proved of great value in studying farm management. To do this, it was necessary to find out what homemakers accomplish in one day. The accomplishment in food preparation has been measured in one study (Moser, 1935), but no other such studies have come to the writer's attention. With this measure, households with similar work loads could be compared and practices studied; also, time used for certain work could be related to output, and average efficiency for a group of homemakers could be calculated as a basis with which to compare the individual accomplishments.

Furthermore, since a recent list of the different tasks which homemakers perform, and the time required for each in the average home, were not available, it seemed desirable to compile such a list in order to learn what tasks were being done currently in New York farm homes, their relative importance in time consumed, and, by comparison with previous studies, any recent changes.

Since it was known that a small child adds to the work load, it was decided to study the teaching to children of certain routine activities in relation to the homemaker's use of time.

METHOD OF STUDY

Many of the previous studies of the use of time were made about 1926, in cooperation with the Bureau of Home Economics of the United States Department of Agriculture. The cooperating homemakers kept a record of their use of time for a typical week. Because the homemaker was asked to keep a record, probably only the more intelligent and interested homemakers who had time to keep a record reported.[2] The survey

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[1] The study on which this bulletin is based is reported more completely in a thesis presented to the Faculty of the Graduate School of Cornell University, September 1938, in partial fulfillment of the requirements for the degree of doctor of philosophy.

[2] For example, there were children less than one year old in 5 per cent of the Genesee County households studied, but in only 3 per cent of the households included in the study directed by the federal Bureau of Home Economics; and there were six or more persons in 24 per cent of the households in the Genesee County study, as compared with 17 per cent of the households in the study directed by the Bureau of Home Economics.

method is more likely to include a typical group of homemakers, and therefore it was decided to use that method in the present study.

Genesee County was chosen as the area for study, and three townships were selected to represent the good farming areas and three to represent the poorer areas.[3] The incomes from farming in Genesee County are considerably above the average for the State. The poorest farming sections were omitted because they were occupied largely by foreign families who had moved from Buffalo during the depression, and, while there was no objection to including homemakers who spoke little or no English, it did not seem desirable to add to the study the possible cause of variation in time used for homemaking activities which foreign customs might entail. The best farming land in the county is muck; but, since it is not typical of New York State, the muck-land area was avoided.

An attempt was made to obtain records from farm families who either owned or were tenants on the farms they operated and who received most of their income from farming. From the 1030 homes visited, 762 of which satisfied the requirements of the study, 551 records were obtained, and 502 of these were used in the final analysis.

The interviews for the spring records were held from March 16 to May 9, 1936; 61 per cent of the records were taken during the month of April. All the women were interviewed personally by an enumerator.[4] In addition, 47 of these homemakers were visited in the summer, fall, and winter to obtain seasonal records.

THE HOUSEHOLDS

Of the 2219 individuals in the households studied, 23 per cent were homemakers and 20 per cent were husbands of the homemakers (table 1).

TABLE 1. RELATIONSHIP OF HOUSEHOLD MEMBERS TO THE HOMEMAKER
(502 farm households in Genesee County, New York, spring, 1936)

Household member's relationship to homemaker	Number of persons
Homemaker	502
Son or son-in-law	457
Husband	448
Daughter or daughter-in-law	404
Brother or brother-in-law	49
Mother or mother-in-law	39
Father or father-in-law	38
Grandson	23
Granddaughter	21
Sister or sister-in-law or half sister	20
Nephew	13
Uncle	7
Niece	6
Aunt	3
Cousin	2*
No relation	187†
All persons	2,219

*1 male and 1 female.
†162 males and 25 females.

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[3] The townships studied were selected with the advice and assistance of Professor T. E. LaMont and J. N. Efferson, of the Department of Agricultural Economics and Farm Management of the New York State College of Agriculture, who had made land-utilization maps of Genesee County in the preceding year.

[4] Jane Becker, Ethel Lund, and Lucile Coggshall assisted in taking the spring records. Ethel Lund, Ruth Henderson, and Margaret Tyler assisted in taking records in the other seasons.

Of the homemakers, 89 per cent were keeping house for their husbands, and most of the others were keeping house for their sons, brothers, or fathers. None of the women were employed as paid housekeepers, households having paid housekeepers not being included in the study. There were 177 more males than females in the households studied.

SIZE AND COMPOSITION

One of the problems, in a study such as this, is to determine how to measure the size of the household. Any household has about the same relative size when measured by the number of persons, the number of meals served, or the number of lodgings, but for certain purposes one of these measures may be slightly better than the others. All of these measures were used in the present study, but the number of persons in the household was used the most often. This measure is easy to calculate and easy for the reader to understand. The number of meals served was used in studying the effect of size of household on time used for food preparation and dishwashing.

Both the number of children under 15 years of age, and the age of the youngest person, were used as indicators of composition of the household. In general, the age of the youngest person seems to show more clearly the relationship between composition of the household and time used. When the number of children in the household is used to indicate composition of the household, the time spent for care of individual family members usually increases with the number of children, a positive correlation. When the age of the youngest person is used, the time spent usually decreases as the age increases, a negative correlation.

The average number of persons in the household was 4.4, but the number varied from 2 to 13 persons. More than half of the households could be classed as *small,* since they consisted of two, three, or four persons (table 2).

TABLE 2. NUMBER OF PERSONS IN THE HOUSEHOLD
(502 farm households in Genesee County, New York, spring, 1936)

Number of persons	Number of households	Per cent of households	Cumulative per cent
2	75	15	15
3	111	22	37
4	112	22	59
5	86	17	76
6	43	9	85
7	37	7	92
8	21	4	96
9 or more	17	4	100
Total	502	100	XXX

The number of individual meals served included regular meals served to household members and to guests, and lunch pails packed for members of the household. The number of meals served during the week varied from 28 to 275, and averaged 96. An average of about 3 guest meals per household were served during the week.

The number of lodgings furnished was calculated from the number of nights the household members were at home and the number of lodgings furnished to guests. The number of lodgings furnished during the week varied from 13 to 91, and averaged 31. The 502 households furnished a total of 195 extra lodgings during the week, or an average of 0.4 per household.

In half of the households, the youngest person was 15 years of age or older (table 3); in the remaining households, there were from one to nine children under 15 years; only 9 per cent of the households had four or more children under 15 years of age. About one-fourth of the households had children under 6 years of age, but only 5 per cent of them had children under 1 year of age. In 63 per cent of the households, the homemaker was the only female over 14 years of age. More than half of the households of six or more persons, but only 16 per cent of the households of five persons, had one or more children under 5 years of age (table 4).

TABLE 3. NUMBER OF CHILDREN UNDER 15 YEARS OF AGE IN THE HOUSEHOLD
(497 farm households in Genesee County, New York, spring, 1936)

Number of children under 15 years of age	Number of households	Per cent of households
0	250	50
1	111	22
2	62	13
3	31	6
4 or more	43	9
Total	497	100

TABLE 4. NUMBER OF PERSONS IN THE HOUSEHOLD, AND AGE OF THE YOUNGEST PERSON
(492 farm households in Genesee County, New York, spring, 1936)

Number of persons	Number of households	Per cent of households where the youngest person was—			
		Under 5 years	5–14 years	15–24 years	25 years or over
2	73	0	1	3	96
3	107	5	16	34	45
4	109	18	33	31	18
5	85	16	55	24	5
6 or more	118	54	39	6	1
All households	492	21	30	20	29

Children under 15 years of age comprised half of the persons in the households of eight or more persons.

ILLNESSES

Relatively few of the homemakers reported that any person in the household had been ill during the week preceding the interview. There were 95 homemakers who said they had been ill during the past year, and 43 of these had been ill for more than two weeks. In about one-fifth of the households there had been some illness of persons other than the homemaker during the past year, and in about half of these the illness had totaled more than three weeks. Since illness was not usual, little account was taken in this study of the effect of the health of household members on the time used for homemaking. In households where there was a permanent invalid, the time used for care of family members was accordingly high. The homemakers usually remembered more about their own illnesses during the previous year than about the illness of other household members.

THE HOMEMAKERS

The age of the homemakers varied from 17 to 81 years, but both the average and the median were 47 years. Two-thirds of the homemakers were between 35 and 59 years of age.

The homemakers over 45 years of age usually were in smaller households than were those under 45 years of age. The children in the households were usually sons or daughters of the homemaker, but in some cases there were grandchildren and others. Most of the children under 15 years of age were in households where the homemakers were between 35 and 44 years of age.

About half of the homemakers had had no formal schooling beyond the eighth grade. Approximately 42 per cent had attended high school, and 11 per cent had had some training beyond high school. Of the homemakers under 50 years of age, 61 per cent had had more than a grade-school education, as compared with 51 per cent of the homemakers 50 years of age or older.

Apparently few of the homemakers had had an opportunity to study homemaking in school; only 47 of 502 homemakers said they had had any training in homemaking in school before their marriage. Nearly all of the homemakers said that in their youth they had learned about homemaking from their mothers.

A total of 359, or about 75 per cent, of the married women said they had been gainfully employed before their marriage. Less than half of these had done housework outside of their home, although this was the most frequently mentioned occupation; several had taught school, clerked in stores, or done office work or nursing. There were 77 different occupations reported. Most of the occupations would have been classified as unskilled labor, but probably the homemakers earned enough money to support themselves.

THE HOUSE AND ITS EQUIPMENT

No attempt was made to study housing conditions in detail, but those conditions which might affect the homemaker's use of time were recorded. The large pieces of equipment and the more important conveniences used by the homemaker were listed.

SIZE OF THE HOUSE

Most of the houses were large, averaging ten rooms (table 5). Half of the houses had eight to ten rooms; the smallest had one room, and the largest had eighteen. Not all of the rooms were used regularly. In

TABLE 5. NUMBER OF ROOMS REQUIRING DAILY CARE, AND NUMBER OF ROOMS IN THE HOUSE

(497 farmhouses in Genesee County, New York, spring, 1936)

Number of rooms in house	Number of rooms requiring daily care						
	Less than 4	4	5	6	7	8 or more	Total
	Number of houses						
Less than 7	9	8	12	9	..	..	38
7	6	9	10	5	11	..	41
8	13	12	16	14	16	14	85
9	11	12	17	17	12	10	79
10	14	11	23	20	6	10	84
11	10	12	12	5	3	6	48
12 or more	17	18	23	22	19	23	122
Total	80	82	113	92	67	63	497

order to obtain some measure of the intensity of use of rooms in the house, the homemaker was asked how many rooms required daily care. Some homemakers considered bedrooms as requiring daily care and others did not, which probably accounts for a wider variation than would have been expected. Half of the homemakers said they had four, five, or six rooms requiring daily care. The average number of rooms requiring daily care was five; the lowest, one; and the highest, twelve.

The number of rooms requiring daily care was not closely related to the number of rooms in the house. In nearly every size of house, half or more of the homemakers said that less than six rooms required daily care, indicating that many of the houses were too large for the families living in them. Since extra rooms may be desirable in any house, some of the rooms not requiring daily care may have been needed. Furthermore, farmhouses must be large enough to accommodate families of various sizes who are operating the farm from time to time. However, probably many of the larger houses would never be entirely used by families today.

EQUIPMENT AND CONVENIENCES[5]

The houses had more conveniences than would have been expected, but these families were above the average financially (page 14). Some equipment saves time; some saves energy; some makes it possible to do a better job; and some may have more than one of these advantages.

More than two-thirds of the households used electricity for lighting (table 6). Half of them had furnaces, and half had hardwood floors, but only 30 per cent had running water. It is difficult to obtain a good water supply in some parts of the county. The number of houses having various combinations of these conveniences was less than the number

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[5] In studying equipment, battery radios which were not working were included because they might be easily repaired. If the sink, the washing machine, the vacuum cleaner, the iron, the stove, or the furnace was broken or was not being used because of some defect, or if any of these was electric and the house was not electrified, such pieces of equipment were not counted because they would not have affected the homemaker's use of time during the past week. If the homemaker used electrical equipment belonging to other persons, as a few did, she was counted as owning the equipment, since one of the objects of this study was to determine the relationship of equipment to time used in work.

TABLE 6. NUMBER OF HOUSES HAVING VARIOUS HOUSEHOLD CONVENIENCES
(502 farmhouses in Genesee County, New York, spring, 1936)

Convenience	Number of houses	Per cent of houses
Electricity	346	68
Hardwood floors	266	54
Furnace	256	50
Running water	150	30
Electricity and furnace	206	42
Electricity and hardwood floors	187	37
Electricity and running water	129	26
Running water and furnace	121	24
Running water and hardwood floors	105	21
Furnace and hardwood floors	152	30
Electricity, hardwood floors, and furnace	171	34
Electricity, running water, and furnace	110	22
Electricity, running water, and hardwood floors	107	21
Running water, furnace, and hardwood floors	87	17
All four conveniences	91	18

having any one of them. Only 18 per cent had electricity, running water, hardwood floors, and a furnace; 22 per cent had electricity, running water, and a furnace.

The radio was the most common piece of equipment listed; two-thirds of the households had electric radios and 18 per cent had battery radios (table 7). A total of 79 per cent of the households had washing machines, three-fourths of which were electric. About two-thirds of the families used electric irons and one-third used sadirons. Electric ironers were owned by only seven families. More than half of the households

TABLE 7. NUMBER OF HOMES HAVING CERTAIN HOUSEHOLD EQUIPMENT
(502 farm homes in Genesee County, New York, spring, 1936)

Equipment	Number of homes		Per cent of homes	
Radio		421		84
Electric	331		66	
Battery	90		18	
Washing machine		401		79
Electric	293		58	
Hand-power	62		12	
Gas-engine	46		9	
Vacuum cleaner		289		57
Electric	227		45	
Hand-power	62		12	
Refrigerator		209		42
Ice	135		27	
Electric	68		14	
Gas or kerosene	6		1	
Iron		496		99
Electric	320		64	
Sad	169		34	
Ironer	7		1	
Telephone		285		57
Bathroom		117		23

had a vacuum cleaner; and three-fourths of these were electric. Less than half of the households had an icebox or an electric, gas, or kerosene refrigerator, and, of those having either, the majority had an icebox. More than half of the households had a telephone. Only 23 per cent had a bathroom.

About three-fourths of the homemakers used wood for the cooking fuel in winter, and 40 per cent of them used it in summer. The homemakers who used kerosene, electricity, gasoline, and gas in winter used the same fuel in summer. Of those using coal in winter, 17 per cent used coal in summer, 26 per cent used kerosene, 23 per cent used wood, and 17 per cent used electricity. Of those using wood in winter, 54 per cent used wood in summer, 25 per cent used kerosene, and 10 per cent used gas. Of those using both wood and coal in winter, 27 per cent used kerosene in summer, 14 per cent used gas, and 45 per cent used wood and coal. There were 16 homemakers who used electricity for cooking in winter and 49 who used it in summer. There were 40 homemakers who used gas in winter and 83 who used it in summer. On some of the farms visited there were natural gas wells, and it is usual for the owners of such farms to receive gas for their own use as a part of the income from the well.

Half of the homes had furnaces for heating. Most of the other houses were heated by coal or wood stoves. In 5 per cent of the households fireplaces were used, but these were in addition to some other method of heating.

Electricity was used for lighting in 68 per cent of the homes, 18 per cent used kerosene, 9 per cent used gas, and a few used gasoline lights.

Time-saving equipment

When the homemaker was asked what equipment she had which she considered to be the most time-saving, no list was suggested to her. The chief value of answers to this question, therefore, is that they represent the spontaneous replies of a large number of homemakers, and indicate that almost any piece of equipment may be considered time-saving by some person.

More different kinds of equipment used for preparing and cooking meals were considered time-saving than for any other household tasks, which is not surprising since so large a proportion of the working time is spent on this task. The washing machine was the one piece of equipment most frequently listed, with the electric iron second and the electric vacuum cleaner third (table 8). More than half of the homemakers using washing machines, electric irons, electric ironers, electric vacuum cleaners, and electric stoves or hot plates, listed them among their time-saving equipment. Electric washing machines, irons, and vacuum cleaners did save time, as is shown later (pages 48–49 and 76). There were not enough electric stoves and ironers to permit comparisons.

If a check list had been used, recalling various kinds of equipment to the minds of the homemakers, the number reporting different kinds of equipment as time-saving would probably be changed; the relative frequency of mentioning certain types of equipment also might be changed.

TABLE 8. NUMBER OF HOMEMAKERS MENTIONING VARIOUS PIECES OF EQUIPMENT AS TIME-SAVING
(501 farm homemakers in Genesee County, New York, spring, 1936)

Equipment	Homemakers mentioning the equipment as time-saving*		Per cent of homemakers having the equipment who mentioned it as time-saving
	Number	Per cent	
Washing machine	270	54	67
Electric iron	179	36	56
Electric vacuum cleaner	172	34	60
Electricity or electric lights	45	9	13
Running water	41	8	27
Gas stove or plate	33	7	35
Electric refrigerator	32	6	47
Electric stove or hot plate	32	6	56
Mop wringer	22	4	..
Electric mixer	19	4	..
Waterless cooker or steamer	18	4	..
Bread mixer	15	3	..
Gas or gas lights	14	3	..
Congoleum or linoleum rugs	12	2	..
Carpet sweeper	11	2	..
Oil stove	11	2	8
Bathroom	9	2	8
Sewing machine	8	2	..
Kitchen cabinet	8	2	..
Electric toaster	8	2	..
Pressure cooker	8	2	..
Hardwood floors	7	1	3
Electric ironer	6	1	86
Dust mop	6	1	..
Furnace	5	1	2
Other equipment	67	13	..
No equipment	70	14	..

*Some homemakers may have listed more than one piece of equipment.

Running water and electric lights would probably be mentioned by a higher proportion of the homemakers using them. As a result of the information gathered from these homemakers, a check list could be made and used in the future.

FLOORS AND FLOOR COVERINGS

Little was done with the information about floors and floor coverings, because time used for routine care of the house proved to be associated with the number of rooms requiring daily care, and because the type of floor and the kind of floor covering varied widely as did the size of the rooms and the intensity of their use by the family. A good softwood floor may be easier to take care of than an old hardwood floor, and any type of floor may be covered with a floor covering which makes cleaning easier or harder.

More kitchens were found to have hardwood floors than any other room in the house. About 60 per cent of the kitchen floors were softwood and 40 per cent were hardwood. Nearly all of the other rooms had softwood floors.

Nearly all of the kitchen floors were covered with linoleum or a printed floor covering. The dining-room floors were usually covered with linoleum, a printed floor covering, or a large rug. Practically all of the living-room floors were covered with large rugs, and the bedroom floors with small or large rugs. Half of the stairs were bare, and one-fourth had rubber treads. Most of the back-room floors were bare.

FINANCIAL STATUS

The number of farms in the different land classes and farm classifications is shown in table 9. A comparison of the percentage of records obtained in each land class and farm classification, with the farms in the county as a whole, indicated a tendency to obtain records from the more prosperous homes. More of the records were obtained from families with good, very good, and excellent farms, and in land class V, than if they had corresponded with the distribution for the county as a whole.

TABLE 9. LAND CLASS AND FARM CLASSIFICATION
(502 farms in Genesee County, New York, spring, 1936)

Farm classification	Number of farms in land class*			Total
	III	IV	V	
Poor	8	8	2	18
Fair	48	63	28	139
Good	28	87	96	211
Very good	7	18	56	81
Excellent	0	3	15	18
Unclassified	8	10	17	35
Total	99	189	214	502

*The land is classified numerically; the higher the number, the greater is the intensity of use to which the land is adapted, and usually the higher is the farm income. The farms are classified according to the size and condition of the buildings, and some other factors. Occupied farms are classed as poor, fair, good, very good, and excellent. This is virtually a classification on the basis of income over a period of years.

Records of capital, indebtedness, and net worth were obtained from 199 families. The distribution of these families within the different land classes and farm classifications was nearly the same as the distribution of the entire group, indicating that they could be considered as typical of the group.

The average capital for all families reporting was $9565. About two-thirds of the families had less than $10,000 capital. The average indebtedness for the families reporting was $1412, but more than half of the families had no indebtedness or very little. When the indebtedness for each family was subtracted from the capital, the average net worth was found to be $7818 per family reporting.

Farm classification was more closely associated with capital than was land class. Capital increased consistently with an improvement in the farm classification, and tended to be higher in the better land classes.

Total indebtedness was decidedly higher in the better land classes, and tended to be higher in the better farm classifications. The ratio of debts to capital tended to increase with an improvement in land class and to decrease in the better farm classifications.

Net worth increased decidedly from the lowest farm classification to the highest. It tended to be about the same in all land classes.

There were about three owners to every tenant. Net worth and capital for tenants increased with land class, but was not related to farm classification.

Previous studies have shown that capital is a better indication of a farm family's financial status than is income.[6] Therefore it was felt that farm classification, being closely associated with capital, could be used as a measure of financial status.

Of the homemakers 50 years of age or older, 42 per cent were in the group of families having a net worth of $8950 or more, as compared with 32 per cent of the homemakers less than 35 years of age. This is to be expected with farm families, in which net worth tends to increase with the age of the operator.

As the land class improved, the percentage of homes that had sinks with drains increased, and the percentage that had either a cesspool or a septic tank increased. Also, the percentage of homes with a vacuum cleaner, a furnace, and a telephone increased. Of those that had electricity, the percentage with an electric radio and an electric vacuum cleaner increased. The percentage that used wood for cooking fuel in winter and in summer decreased. There is a higher proportion of wooded land in the lower land classes. In land class V, the farmers may have had less time to spend in getting out wood, since their farms were largely dairy and potato farms. In general, the homes in land class V were better equipped than were those in land class III.

As the farm classification improved, the percentage of homes that had running water, a bathroom, a cesspool or a septic tank, electricity, a vacuum cleaner, a power washing machine, an electric iron or ironer, an electric radio, electric or ice refrigeration, a furnace, a telephone, and some hardwood floors, increased consistently (appendix, table 64, page 84). Of the homes having electricity, the percentage that had an electric washing machine, iron or ironer, vacuum cleaner, or refrigerator, also increased from the lowest to the highest farm classification. A higher percentage of the excellent farms than of the others had both electricity and telephone, or both running water and electricity, or both running water and furnace, or both electricity and furnace, or all of the three last-named conveniences. The type of cooking fuel used apparently had no relationship to farm classification.

As the family capital increased, the percentage of homes having running water increased, as did also the percentage having a sink with drain, electricity, or a furnace. Indebtedness did not seem to be related to the equipment in the home.

As the net worth of the family increased, the percentage of families who had one or more of the following conveniences increased: electricity, a sink with drain, running water, a furnace, a bathroom, electric or ice refrigeration, an electric radio, a telephone; of the families having electricity, the percentage with one or more of the following conveniences increased: an electric radio, a washing machine, a vacuum cleaner, a stove, a refrigerator; the percentage of families having running water and electricity or a furnace, or all three conveniences, tended to increase.

In general, the equipment was better in the houses on a hard road than in the houses on a dirt road. The percentage of households that had a telephone increased with the distance from a hard road.

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[6] Unpublished data of the Department of Economics of the Household and Household Management New York State College of Home Economics.

From this study, it seems that household equipment is more closely related to either farm classification or capital than to land class or net worth, and that it is not related to indebtedness.

As the farm classification improved from poor to excellent, the percentage of homemakers who had more than a high-school education increased from 6 to 17; and as the land class improved from III to V, this percentage increased from 10 to 17.

As the land class improved, the number of rooms in the house increased. There seemed to be no relationship between land class and number of persons in the household, but the age of the youngest person decreased slightly as the land class improved.

The average number of rooms in the house increased from 8 in the poor-farm classification to 12 in the excellent-farm classification. The number of persons in the household increased, and the age of the youngest person decreased, as the farm classification improved.

ACTIVITIES OF THE HOMEMAKERS

In the interview, the homemaker was asked first to account for her time on the preceding day.[7] The average time accounted for on this day by the homemakers was 3 minutes more than 24 hours (table 10).

TABLE 10. TIME ACCOUNTED FOR BY THE HOMEMAKER ON THE WEEKDAY PRECEDING THE INTERVIEW*

(489 farm homemakers in Genesee County, New York, spring, 1936)

Time accounted for	Number of homemakers	Per cent of homemakers	Cumulative per cent
24 hours	50	10	10
24 hours ±1–24 minutes	153	31	41
24 hours ±25–44 minutes	116	24	65
24 hours ±45–64 minutes	97	20	85
24 hours ±65 minutes or more	73	15	100

*The average time accounted for was 3 minutes more than 24 hours.

The homemaker was next asked about her time during the preceding week. The week's time record was not checked until later, and the average error was 15 hours a week unaccounted for, or about 9 per cent of the total time. In general, the time record for the preceding day is probably more nearly accurate for tasks performed daily, and the week's figure is more nearly accurate for tasks performed only once a week. If only the day's record had been used, such tasks as washing, ironing, and baking would not have been reported frequently, and therefore the averages computed might have been less nearly accurate.[8] By comparison with other studies and from various other tests, the time reported for homemaking seemed to be reasonably near accuracy.

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[7] The record for the weekday preceding the interview is called *the day's record* or *the weekday's record*. The time used during the week preceding the interview is referred to as time used *during the week*.

[8] The homemakers interviewed were asked questions concerning the time spent on certain homemaking and other activities, and any additional time spent on other activities was recorded. It was somewhat surprising to find that more than 400 different activities were reported by the women. These activities were classified under 33 main headings. The detailed classification of activities of the homemakers is given in the appendix (pages 84 to 86).

The number of homemakers who reported some time spent du the week on the individual homemaking activities, varied from 487 rep ng for preparing dinner to 23 for preserving food (table 11). In o r words, not all of the activities were carried on in every household; furthermore, the homemakers were not the only members of the household who spent time on the homemaking activities (page 31). Most of the tasks that might be classed as routine housework were engaged in during the week by 80 per cent or more of the homemakers. In all of the households, some time was used during the week for meal preparation, bedmaking, daily care of the house, and dishwashing. In less than half of the households, time was used for packing lunch pails, care of individual family members, marketing and account-keeping, sewing, special house-cleaning, upkeep of the house, and food preservation. The women who had children of school age usually spent some time in packing lunch pails. The women with young children generally devoted some time to the care of individual family members. The number of homemakers reporting marketing and account-keeping may be incomplete (page 52).

TABLE 11. NUMBER OF HOMEMAKERS REPORTING VARIOUS ACTIVITIES DURING THE WEEK

(497 farm homemakers in Genesee County, New York, spring, 1936)

Activity	Number of homemakers reporting	Per cent of homemakers reporting
Personal care	497	100
Eating meals	497	100
Food preparation	496	100
Care of house	495	100
Preparing dinner	487	98
Dishwashing	485	98
Daily care of house	483	97
Preparing supper	477	96
Miscellaneous activities*	472	95
Preparing breakfast	470	95
Bedmaking	467	94
Baking	465	94
Washing dinner dishes	461	93
Washing breakfast dishes	443	89
Washing	442	89
Weekly house-cleaning	440	89
Washing supper dishes	426	86
Ironing	416	85
Mending	416	84
Care of fires	404	81
Farm work	400	80
Packing lunch pails	200	40
Care of individual family members	171	34
Marketing and account-keeping	164	33
Other work	149	30
Sewing	120	24
Community activities	107	22
Special house-cleaning	105	21
Fancy-work	95	19
Upkeep of house	46	9
Food preservation	23	5
Care of health or illnesses	19	4

*Includes some leisure.

On the day preceding the interview, three-fourths or more of the homemakers had spent time on meal preparation, dishwashing, daily care of the house, bedmaking, care of fires, farm work, and miscellaneous activities; therefore these may be assumed to be tasks usually performed daily by most homemakers (table 12). For homemakers who had chil-

LE 12. NUMBER OF HOMEMAKERS REPORTING VARIOUS ACTIVITIES DURING THE DAY AND THE WEEK PRECEDING THE INTERVIEW

(497 farm homemakers in Genesee County, New York, spring, 1936)

Activity	Number of homemakers reporting for the preceding–		Per cent reporting for the week who reported for the day
	Week	Day	
Any homemaking activity	497	497	100
Sleeping and resting	497	497	100
Personal care	497	497	100
Eating meals	497	497	100
Food preparation	496	492	99
Care of house	495	490	99
Preparing breakfast	470	464	99
Care of fires	404	397	98
Farm work	400	393	98
Dishwashing	485	469	97
Miscellaneous activities	472	456	97
Bedmaking	467	450	96
Washing breakfast dishes	443	422	95
Preparing supper	477	449	94
Care of individual family members	171	161	94
Preparing dinner	487	455	93
Packing lunch pails	200	184	92
Daily care of house	483	440	91
Washing supper dishes	426	384	90
Washing dinner dishes	461	403	87
Other work	149	118	79
Special house-cleaning	105	76	72
Marketing and account-keeping	164	97	59
Fancy-work	95	47	49
Baking	465	223	48
Community activities	107	49	46
Sewing	120	48	40
Mending	416	109	26
Washing	442	99	22
Ironing	416	92	22
Weekly house-cleaning	440	69	16

dren in the household, care of individual family members and packing lunch pails were daily tasks. Mending, washing, ironing, and weekly house-cleaning were usually reported about once a week. Marketing and account-keeping, fancy-work, baking, community activities, and sewing were usually reported about twice a week by those homemakers who did them at all.

In general, a larger percentage of the homemakers in the households of only two persons engaged in the various homemaking activities, than in the households of seven, eight, or more persons. However, a smaller proportion of the homemakers in the small households reported time spent on baking, washing, mending, care of fires, packing lunch pails, sewing, and care of individual family members. In the larger households there was some tendency for a smaller proportion of the homemakers to spend time on washing breakfast and supper dishes, bedmaking, special house-cleaning, other work, fancy-work, and miscellaneous activities. The percentage of homemakers reporting farm work was highest in the households of three to seven persons. The percentage of homemakers who spent time in ironing was highest in the households of four to six persons.

As the number of children in the household increased, the percentage of homemakers who packed lunch pails and of those who cared for individual family members increased. The percentage of homemakers who reported miscellaneous activities, bedmaking, washing breakfast dishes, weekly house-cleaning, washing supper dishes, ironing, other work, and sewing, was less in the households where there were four or more children than in the other households. The percentage of homemakers who spent time on fancy-work decreased from 26 to 7 as the number of children in the household increased from none to four or more. The percentage of homemakers who reported washing, baking, and taking care of fires was higher in the larger households.

TIME USED

About one-third of the homemaker's 24 hours was used for homemaking activities, 4 per cent for farm work, 45 per cent for personal activities and sleeping and resting, and the remainder for miscellaneous activities (table 13).

TABLE 13. DISTRIBUTION OF THE HOMEMAKER'S TIME DURING THE WEEK
(497 farm homemakers in Genesee County, New York, spring, 1936)

Activity	Average hours spent on activity		Per cent of total time	
Homemaking		51.9		31
Food preparation	16.4		10	
Dishwashing	7.2		4	
Care of house	16.3		10	
Care of clothing and household linens	7.0		4	
Care of individual family members	3.7		2	
Other homemaking	1.5		1	
Farm work		6.8		4
Other work		2.0		1
Personal and sleeping		74.5		45
Leisure and miscellaneous activities		17.5		10
Unaccounted for		15.3		9
Total		168.0		100

The time used by the homemaker for homemaking averaged 52 hours for the week, varying from 5 hours to 120 hours. The day's average was about 8 hours, varying from ⅓ hour to 16 hours. When the time used for farm and other work was added to homemaking, the homemakers worked an average of about 61 hours during the week.

The average amount of time used for sleeping and resting was more than one-third of the 24 hours. Only 10 per cent of the homemaker's time was used for leisure and miscellaneous activities, and 9 per cent of the time was unaccounted for in the records for the week.

The time used during the week by the homemakers for some of the activities was exceedingly variable (table 14; and appendix, table 65, page 87).[9] This was especially true for care of health and for fancy-work, which were not reported by a large proportion of the homemakers. However, for farm work and care of fires, which were reported by 80 per cent or more of the homemakers, the amount of time spent was highly variable.

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[9] The amount of time used by one-half or more of the homemakers was between the first and the third quartiles, and therefore the range between these quartiles indicates the usual amount of time spent by the homemakers.

TABLE 14. VARIABILITY IN TIME USED DURING THE WEEK (PER HOMEMAKER REPORTING)
(497 farm homemakers in Genesee County, New York, spring, 1936)

Activity	Homemakers reporting		Minutes used during the week				Quartile coefficient of variability
	Number	Per cent	Average	First quartile	Median	Third quartile	
Any homemaking activity	497	100	3,115	2,500	3,100	3,700	19
Food preparation	496	100	984	810	960	1,160	18
Preparing breakfast	470	95	171	110	150	210	33
Preparing dinner	487	98	352	240	360	390	25
Preparing supper	477	96	241	180	210	300	29
Baking	465	94	210	120	180	270	42
Packing lunch pails	200	40	77	50	60	90	33
Dishwashing	485	98	446	320	420	560	29
Breakfast dishes	443	89	150	110	110	210	45
Dinner dishes	461	93	180	120	180	210	25
Supper dishes	426	86	158	110	140	210	36
Care of house	495	100	982	690	910	1,210	29
Daily care of house	483	97	383	210	360	480	38
Weekly house-cleaning	440	89	211	120	180	240	33
Special house-cleaning	105	21	334	120	240	360	50
Care of fires	404	81	269	110	210	420	74
Bedmaking	467	94	101	70	110	120	23
Upkeep of house	46	9	411	150	330	480	50
Care of clothing and household linens:							
Washing	442	89	189	120	180	240	33
Ironing	416	84	149	90	120	180	38
Mending	416	84	97	50	60	120	58
Sewing	120	24	191	60	150	240	60
Care of individual family members	171	34	669	210	470	900	73
Marketing and account-keeping	164	33	235	120	180	300	50
Food preservation	23	5	260	90	180	330	67
Farm work	400	80	515	140	320	700	88
Other work	149	30	399	90	210	480	93
Fancy-work	95	19	330	90	180	450	100
Community activities	107	22	289	150	210	390	57
Miscellaneous activities	472	95	984	420	840	1,320	54
Sleeping and resting	497	100	3,666	3,360	3,570	3,950	8
Personal care	497	100	251	140	210	330	45
Eating meals	495	100	551	420	560	630	19
Care of health or illnesses	19	4	488	120	240	840	150

There did not seem to be any relationship between the amount of help received on a task and the variability of the homemaker's time spent on it.

In general, the time used during the day for the different activities varied more than did the time used during the week (table 15; and appendix, table 66, page 88). For tasks performed usually only once or twice during the week, this might be expected; for routine activities, the greater variation in the day's time may have been because help was received on certain days and not on other days. Also, it is possible to plan a day so that less time is used for homemaking and more for community activities or leisure; or to plan so that less time is used for meal preparation on days when other parts of homemaking, such as washing or weekly house-cleaning, are to be done.

Both the size of the household and the number of children under 15

TABLE 15. VARIABILITY IN TIME USED ON THE WEEKDAY PRECEDING THE INTERVIEW (PER HOMEMAKER REPORTING)
(497 farm homemakers in Genesee County, New York, spring, 1936)

Activity	Homemakers reporting		Minutes used during the day				Quartile coefficient of variability
	Number	Per cent	Average	First quartile	Median	Third quartile	
Any homemaking activity	497	100	493	370	500	610	24
Food preparation	492	99	139	100	130	170	27
Preparing breakfast	464	93	24	15	20	30	38
Preparing dinner	455	92	48	30	50	60	30
Preparing supper	449	90	37	30	30	45	25
Baking	223	45	62	30	50	80	50
Packing lunch pails	184	37	15	10	15	15	17
Dishwashing	469	94	65	50	60	80	25
Breakfast dishes	422	85	22	15	20	30	38
Dinner dishes	403	81	27	15	30	30	25
Supper dishes	384	77	24	15	20	30	38
Care of house	490	99	160	80	130	200	46
Daily care of house	440	89	64	30	60	90	50
Weekly house-cleaning	69	14	106	40	90	120	44
Special house-cleaning	76	15	172	60	150	240	60
Care of fires	397	80	40	20	30	60	67
Bedmaking	450	91	14	10	15	20	33
Care of clothing and household linens:							
Washing	99	20	134	90	120	180	38
Ironing	92	19	110	60	90	120	33
Mending	109	22	62	30	60	90	50
Sewing	48	10	108	50	90	170	67
Care of individual family members	161	32	102	30	75	145	77
Marketing and account-keeping	97	20	166	90	150	180	30
Farm work	393	79	88	25	45	120	106
Other work	118	24	142	40	90	180	78
Fancy-work	47	9	115	50	120	150	42
Community activities	49	10	233	130	180	310	50
Miscellaneous activities	456	92	188	90	150	240	50
Sleeping and resting	497	100	530	480	510	570	9
Personal care	497	100	39	20	30	50	50
Eating meals	497	100	79	60	80	90	19

years of age were related to the time used by the homemaker for all homemaking activities; the more closely associated factor was the number of children in the household (table 16; and appendix, table 67, page 89). The presence of children in the household seemed to be closely related also to the time used for preparing breakfast and supper, ironing, fancy-work, marketing and account-keeping, food preparation, dishwashing, care of individual family members, and miscellaneous activities. The number of persons in the household seemed to be closely related to the time used by the homemaker for bedmaking, washing supper dishes, baking, washing, mending, sewing, personal care, special house-cleaning, and sleeping and resting. Neither factor seemed to be related to the time used for any activity in the routine care of the house except bedmaking, or for farm work, other work, or eating meals.

Although the homemaker's use of time for food preparation, dishwashing, and all homemaking activities seemed to be more closely associated with the presence or absence of children than with the size of the

TABLE 16. NUMBER OF PERSONS IN THE HOUSEHOLD AND NUMBER OF CHILDREN UNDER 15 YEARS OF AGE, AS RELATED TO TIME USED BY THE HOMEMAKER FOR CERTAIN ACTIVITIES

(497 farm households in Genesee County, New York, spring, 1936)

Number of children	Number of persons	
	Less than 5	5 or more
	Minutes used during the week for—	
	All homemaking activities	
0	2,757	2,746
1 or more	3,292	3,563
	Fancy-work	
0	85	107
1 or more	36	26
	Miscellaneous activities	
0	1,055	1,232
1 or more	877	746
	Care of individual family members	
0	47	76
1 or more	287	456
	Sleeping and resting	
0	3,776	3,621
1 or more	3,665	3,532

household, the time used by all workers for these activities appeared to be influenced more by the size of the household than by the presence or absence of children (table 17; and appendix, table 68, page 90). The number of persons in the household was closely related to the time used by all workers for all care of the house, and to the total amount of help received by the homemaker (table 18). Care of individual family members was more closely associated with the presence or absence of children than with the number of persons in the household (appendix, table 68, page 90).

TABLE 17. NUMBER OF PERSONS IN THE HOUSEHOLD AND NUMBER OF CHILDREN UNDER 15 YEARS OF AGE, AS RELATED TO TIME USED BY ALL WORKERS FOR CERTAIN ACTIVITIES

(497 farm households in Genesee County, New York, spring, 1936)

Number of children	Number of persons	
	Less than 5	5 or more
	Minutes used during the week for—	
	Food preparation	
0	1,002	1,259
1 or more	1,038	1,327
	Dishwashing	
0	513	670
1 or more	542	720
	Homemaking	
0	3,281	3,973
1 or more	3,694	4,582

TABLE 18. NUMBER OF PERSONS IN THE HOUSEHOLD AND NUMBER OF CHILDREN UNDER 15 YEARS OF AGE, AS RELATED TO TIME USED BY HELPERS FOR HOMEMAKING

(497 farm households in Genesee County, New York, spring, 1936)

Number of children	Number of persons	
	Less than 5	5 or more
	Minutes used during the week by helpers	
0	506	1,225
1 or more	392	994

ALL HOMEMAKING ACTIVITIES[10]

The average time used during the week for all homemaking was about 52 hours for the homemakers and 11½ hours for the helpers, or a week's total of about 64 hours (tables 19, 20, and 21). Most of the homemakers

TABLE 19. TIME USED DURING THE WEEK BY THE HOMEMAKER FOR ALL HOMEMAKING ACTIVITIES

(450 farm homemakers in Genesee County, New York, spring, 1936)

Hours*	Number of homemakers	Per cent of homemakers	Cumulative per cent
Less than 35	50	11	11
35–44	109	24	35
45–54	93	21	56
55–64	93	21	77
65–74	72	16	93
75 or more	32	7	100
All homemakers	450	100	XXX

*The average was 52 hours.

TABLE 20. AMOUNT OF HELP RECEIVED DURING THE WEEK BY THE HOMEMAKER ON ALL HOMEMAKING ACTIVITIES

(477 farm households in Genesee County, New York, spring, 1936)

Hours*	Number of households	Per cent of households	Cumulative per cent
None	83	17	17
0–3	122	26	43
4–7	78	16	59
8–11	41	9	68
12–15	38	8	76
16–19	21	4	80
20–23	15	3	83
24 or more	79	17	100
Total	477	100	XXX

*The average was 11½ hours.

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[10] Only 450 complete records of the time used for homemaking by the homemaker were obtained. Some records were discarded because the enumerator had recorded time used for washing milk dishes and for washing breakfast dishes together, or had reported sewing or mending with leisure activities. A few of the incomplete records were caused by the homemaker's refusal to give certain information.

TABLE 21. TIME USED DURING THE WEEK BY ALL WORKERS FOR ALL HOMEMAKING ACTIVITIES
(440 farm households in Genesee County, New York, spring, 1936)

Hours*	Number of households	Per cent of households	Cumulative per cent
Less than 45	78	18	18
45–54	78	18	36
55–64	104	23	59
65–74	78	18	77
75–84	44	10	87
85–94	25	6	93
95 or more	33	7	100
Total	440	100	XXX

*The average was 63¾ hours.

used between 5 and 9 hours each day during the week for homemaking. There were 32 homemakers who used an average of more than 10½ hours daily during the week. In most of the households, all workers used an average of about 8 hours a day during the week for homemaking, but in 33 households the average was about 15 hours daily.

Feeding the family and care of the house together accounted for more than three-fourths of all the time used by the homemaker for homemaking (table 22). The largest percentage of the homemakers' time was used for food preparation; meal preparation accounted for 24 per cent of the total time for homemaking, baking for 6 per cent, and packing lunch pails for 1 per cent. Time used for routine care of the house and bedmaking was 21 per cent of the total, and care of fires was 7 per cent.

TABLE 22. PERCENTAGE DISTRIBUTION OF TIME USED FOR HOMEMAKING DURING THE WEEK
(497 farm homes in Genesee County, New York, spring, 1936)

Activity	Per cent of the week's homemaking time*			
	Homemakers		All workers	
Food preparation		32		30
Preparing breakfast, dinner, supper	24		22	
Packing lunch pails	1		1	
Baking	6		6	
Other food-preparation work	1		1	
Care of house		31		33
Routine care of the house and bedmaking	21		21	
Care of fires	7		8	
Other work in care of house	3		4	
Dishwashing		14		16
Care of clothing and household linens		13		13
Washing	5		5	
Ironing	4		4	
Mending	3		3	
Sewing	1		1	
Care of individual family members		7		6
Marketing and account-keeping		3		2
All homemaking		100		100

*The average time spent by the homemaker on homemaking activities was about 52 hours during the week.

Dishwashing accounted for 14 per cent of the total, care of clothing and household linens for 13 per cent, care of individual family members for 7 per cent, and marketing and account-keeping for 3 per cent.

Of the time used by all workers for homemaking, 33 per cent was used for care of the house and 30 per cent for food preparation.

Meal preparation, dishwashing, packing lunch pails, baking, washing, and ironing are usually done in the kitchen. These tasks required 54 per cent of the homemaking time. Including the care of the kitchen and the kitchen fire and some other tasks which may be done in the kitchen, it is probable that two-thirds of the time spent on homemaking activities was spent in the kitchen.

Variation in time used

As the time used during the week by the homemaker for all homemaking activities increased, the percentage of this time used for food preparation, dishwashing, and marketing and account-keeping decreased (table 23). The percentage of time used for care of the house and care of clothing and household linens remained about the same, which means an increase in actual time. The percentage of time used for care of individual family members increased, which represents a relatively large actual increase in time. Probably the women who had small children used the same amount of time or less for routine homemaking, and more time for care of individual family members, therefore working longer hours than did the women with no children. The homemakers were fairly accurate in their records of their own time, but errors may have occurred in the estimate of time used by other persons in the household.

TABLE 23. TIME USED DURING THE WEEK BY THE HOMEMAKER FOR ALL HOMEMAKING ACTIVITIES, AND PERCENTAGE OF TIME USED FOR VARIOUS PARTS OF HOMEMAKING

(450 farm homemakers in Genesee County, New York, spring, 1936)

	Minutes used for homemaking					All homemakers
	Less than 2,350	2,350–2,949	2,950–3,549	3,550–4,149	4,150 or more	
Number of homemakers	89	110	119	72	60	450
Number of persons in the household	3.5	4.0	4.3	4.6	6.2	4.4
Number of children under 15 years of age in the household	0.4	0.6	1.0	1.3	2.8	1.1
	Per cent of homemaking time					
Food preparation	36	35	32	28	27	31
Care of house	30	31	33	33	29	32
Dishwashing	16	16	15	13	11	14
Care of clothing and household linens	13	12	14	13	13	13
Care of individual family members	2	3	3	11	18	7
Marketing and account-keeping	3	3	3	2	2	3
All homemaking	100	100	100	100	100	100

As the time used by the homemaker for homemaking increased, the percentage of her total time that was used for homemaking increased (table 24). This was accompanied by a decrease in percentage of time used for farm work, sleeping and resting, and miscellaneous activities. The percentage of time used for care of the house, care of clothing and household linens, and care of individual family members, more than doubled. The percentage of time unaccounted for decreased rapidly, indicating that the homemaking time may have been reported more carefully than the leisure time.

TABLE 24. TIME USED DURING THE WEEK BY THE HOMEMAKER FOR ALL HOMEMAKING ACTIVITIES, AND PERCENTAGE OF TIME USED FOR VARIOUS ACTIVITIES
(450 farm homemakers in Genesee County, New York, spring, 1936)

	Minutes used for homemaking					All homemakers
	Less than 2,350	2,350–2,949	2,950–3,549	3,550–4,149	4,150 or more	
Number of homemakers	89	110	119	72	60	450
Number of persons in the household	3.5	4.0	4.3	4.6	6.2	4.4
Number of children under 15 years of age in the household	0.4	0.6	1.0	1.3	2.8	1.1
	Per cent of week's time					
All homemaking	19	26	32	38	47	31
Farm work	5	4	4	3	3	4
Other work	2	1	1	1	1	1
Personal care and eating meals	8	8	8	8	8	8
Sleeping and resting	40	37	36	35	33	36
Leisure and miscellaneous activities	14	11	10	9	7	11
Other time*	12	13	9	6	1	9

*Unaccounted-for time.

The percentage of the total time used which was contributed by helpers for various parts of homemaking and for all homemaking, increased as the number of persons in the household increased (table 25). The helpers' time accounted for an average of 28 per cent of the time spent on dishwashing, 22 per cent of that on the care of the house, 16 per cent of

TABLE 25. PERCENTAGE CONTRIBUTED BY HELPERS, OF TOTAL TIME USED DURING THE WEEK FOR VARIOUS PARTS OF HOMEMAKING
(497 farm households in Genesee County, New York, spring, 1936)

Number of persons in household	Number of households	Dishwashing	Care of house	Care of clothing and household linens	Food preparation	Care of individual family members	All homemaking
		Per cent of time					
2	75	5	12	2	2	0	7
3	110	17	18	12	11	25	15
4	111	23	21	15	11	13	16
5	85	32	25	21	13	18	20
6	43	40	27	16	20	13	21
7	36	38	32	19	21	24	24
8 or more	37	50	30	22	25	15	25
All households	497	28	22	16	13	10	17

that on the care of clothing and household linens, 13 per cent of that on food preparation, 10 per cent of that on the care of individual family members, and 17 per cent of the total homemaking time. In households of two persons, helpers did little of the homemaking, except that their time was 12 per cent of that spent on the care of the house. In households of eight or more persons, the helpers' time accounted for 50 per cent of the time used for dishwashing, and 30 per cent of that used for care of the house.

The time used during the week by the homemaker for food preparation, care of clothing and household linens, and care of individual family members, increased as the number of persons in the household increased (table 26). The greatest actual increase was in time used for care of individual family members, which increased, on the average, from 0 to about 14 hours. The time used for marketing and account-keeping, care of house, and dishwashing, remained about the same. In larger households, helpers contributed a greater proportion of the time spent on these tasks. The time used by the homemaker for all homemaking activities increased by about half as the number of persons in the household increased to eight or more.

TABLE 26. NUMBER OF PERSONS IN THE HOUSEHOLD, AS RELATED TO TIME USED BY THE HOMEMAKER DURING THE WEEK FOR ALL HOMEMAKING ACTIVITIES

(497 farm homemakers in Genesee County, New York, spring, 1936)

Number of persons in household	Number of homemakers	Food preparation	Dishwashing	Care of house	Care of clothing and household linens	Care of individual family members	Marketing and account-keeping	All homemaking
		Minutes used by the homemaker						
2	75	851	430	1,000	332	0	78	2,656
3	110	861	399	959	358	64	92	2,750
4	111	1,027	465	1,013	386	193	76	3,213
5	85	1,041	456	959	410	195	59	3,104
6	43	1,040	419	977	519	302	60	3,388
7	36	1,125	497	875	569	413	80	3,583
8 or more	37	1,136	368	1,030	610	852	79	4,085
All households	497	982	434	978	417	218	76	3,114

The time used per capita by the homemaker for care of individual family members increased as the number of persons in the household increased (table 27). The time used for all other homemaking activities decreased. The decrease in time used for care of clothing and household linens was not so great as the other decreases. The greatest decrease was in time used for care of the house, which decreased from about 8 hours to less than 2 hours; the greatest proportionate decreases were in time used for dishwashing and for marketing and account-keeping.

As the number of persons in the household increased from two to eight or more, the time used for all homemaking activities per family nearly doubled, and the help received by the homemaker increased more than six times.

TABLE 27. NUMBER OF PERSONS IN THE HOUSEHOLD, AS RELATED TO TIME USED DURING THE WEEK BY THE HOMEMAKER FOR ALL HOMEMAKING ACTIVITIES (PER PERSON IN THE HOUSEHOLD)

(497 farm homemakers in Genesee County, New York, spring, 1936)

Number of persons in household	Number of homemakers	Food preparation	Dishwashing	Care of house	Care of clothing and household linens	Care of individual family members	Marketing and account-keeping	All homemaking
		Minutes used per person by the homemaker						
2	75	425	215	500	166	0	39	1,328
3	110	287	133	320	119	33	31	917
4	111	257	116	253	96	48	19	803
5	85	208	91	192	82	39	12	621
6	43	173	70	163	87	50	10	565
7	36	161	71	125	81	59	11	512
8 or more	37	127	41	115	68	95	9	455
All households	497	223	98	222	95	49	17	705

The time used during the day was related to the number of persons in the household in the same way as was the time used during the week.

As the number of children in the household increased, the time used during the week by the homemaker for food preparation, care of clothing and household linens, and care of individual family members, increased (table 28). The time used for marketing and account-keeping decreased slightly, that for care of the house and for dishwashing remained about the same, and that for all homemaking activities increased.

TABLE 28. NUMBER OF CHILDREN UNDER 15 YEARS OF AGE, AS RELATED TO TIME USED DURING THE WEEK BY THE HOMEMAKER FOR ALL HOMEMAKING ACTIVITIES

(497 farm homemakers in Genesee County, New York, spring, 1936)

Number of children	Number of homemakers	Food preparation	Care of house	Dishwashing	Care of clothing and household linens	Marketing and account-keeping	Care of individual family members	All homemaking*
		Minutes used by the homemaker						
0	250	906	965	419	354	85	51	2,780
1	111	1,012	991	450	431	64	183	3,166
2	62	1,102	955	499	453	74	312	3,395
3	31	1,009	1,105	420	594	67	618	3,970
4 or more	43	1,161	962	411	582	63	854	4,134
All households	497	982	978	434	417	76	218	3,115

*Includes food preservation.

As the number of children in the household increased, the time used during the week by all workers for food preparation, care of individual family members, and all homemaking activities, increased (table 29); the time used for care of the house remained about the same; the amount of help received by the homemaker increased. The time used by all work-

TABLE 29. Number of Children Under 15 Years of Age, as Related to Time Used during the Week by All Workers for Various Homemaking Activities
(497 farm households in Genesee County, New York, spring, 1936)

	Number of children				Number of children			
	0	1	2	3 or more	0	1	2	3 or more
Number of households	250	111	62	74	250	111	62	74
Number of persons in household	3	4	5	7	3	4	5	7
	Minutes per household				Minutes per person in the household			
Food preparation	1,036	1,154	1,261	1,334	321	260	230	186
Dishwashing	532	604	712	716	166	136	128	100
Care of house	1,228	1,285	1,192	1,357	381	289	217	189
Care of individual family members	38	277	345	878	12	63	63	123
All homemaking activities*	3,366	3,908	4,120	5,046	1,055	888	744	707
Help received in homemaking	595	740	662	987	186	167	121	138

*r = 0.51.

ers for dishwashing increased as the number of children in the household increased, but the time used by homemakers remained about the same. The time used per capita for food preparation, dishwashing, care of the house, and all homemaking decreased as the number of children increased; the time used for care of individual family members increased; the amount of help received per capita by the homemaker decreased.

As the number of persons in the household increased and the age of the youngest person decreased, the time used during the week by all workers for all homemaking activities increased (table 30). The increase was consistent with an increase in the number of persons in the household. The greatest difference was between the group with children less than 5 years of age and the group with children 5 to 14 years of age. More time was used for care of infants than for care of older children. An infant requires an average of about three hours of work a day over and above that required by an adult; in households where there

TABLE 30. Age of the Youngest Person and Number of Persons in the Household, as Related to Time Used during the Week by All Workers for All Homemaking Activities
(492 farm households in Genesee County, New York, spring, 1936)

Age of youngest person (years)*	Number of persons in household			
	2 or 3 persons	4 persons	5 persons	6 or more persons
	Minutes used by all workers			
Less than 5	3,686	4,312	4,542	5,108
5–14	3,173	3,564	3,855	4,443
15–24	3,239	3,979	3,878	.....†
25 or more	3,012	3,963	.....†	.....†

*r = –0.46.
†Less than 5 households reported.

is an infant, some parts of homemaking are omitted or less time is spent on them than would be the case if there were only adults in the household.

In the households where there was running water, about 7 per cent more time was used by all workers for homemaking than in the households where there was no running water, but this difference was not significant. In general, the time used for homemaking activities was less in the households having neither running water nor electricity than in the households having both of these conveniences (table 31). There were slightly fewer persons in the households having neither running water nor electricity. Because of this difference in size of household and because of the variability of time used, it is probable that none of the differences in time used are significant except the difference for care of fires; and that difference is probably not related to presence or absence of running water and electricity.

TABLE 31. RUNNING WATER AND ELECTRICITY, AS RELATED TO VARIOUS OTHER FACTORS

(263 farm households in Genesee County, New York, spring, 1936)

	Households with–	
	Running water and electricity	Neither running water nor electricity
Number of households	129	134
Number of persons in the household	4.6	4.4
Minutes used during the week by the homemaker for all homemaking activities	3,241	3,031
Minutes used during the week by all workers for–		
Washing	220	203
Ironing	164	144
Care of fires	287	344
Food preparation	1,162	1,114
Routine care of house	672	676
Dishwashing	633	548

The equipment used affected the time used for washing, ironing, and house-cleaning (pages 48 and 76).

In households where the homemaker had been ill for one or more days during the preceding week, the homemakers had spent less time on homemaking activities, and helpers had contributed a larger proportion of the total time spent on homemaking, than in households where the homemaker had not been ill. Many things which the homemaker ordinarily would have done may have been left undone during her illness.

The time used for care of individual family members was higher in households of adults where some member of the household had been ill during the preceding week, than in other households of adults.

The women who said they liked all parts of homemaking, used slightly more time for homemaking during the week than did the other women. The women who said they liked no parts of homemaking or who failed to report a preference, used slightly less than the average time.

In view of the larger tenant households, it was not surprising to find that the time used during the week by all workers for all homemaking activities was higher in tenant households.

The time used by all workers for homemaking was not related to either land class or farm classification. The time used for baking and that for mending were not related to farm classification, although these two activities are sometimes thought to be related to financial status.

There were no significant differences among the six townships in the time used by all workers for all homemaking activities.

Practically all of the homemakers had lived in their present home for more than one year and had been keeping house for an average of twenty-four years, and so the time used for homemaking probably was not lengthened by unfamiliarity with the house or with their work. The average length of time these women had been keeping house was eight years more than the length of time they had been living in their present home.

Help received by the homemaker

Only 7 of the homemakers had full-time hired household help. Several of the other homemakers had some hired help during the week. The households where there were hired helpers were not excluded from the study of help received, because they were similar to the households where there was another woman besides the homemaker in the family. With another woman in the household the homemaker received more help than otherwise, whether the second woman was paid or not.

The amount of help received by the homemakers averaged 11½ hours during the week (table 20, page 23). Approximately half, or 283, of the homemakers received less than 8 hours of help during the week, and 36 homemakers received 40 hours or more of help during the week.

Care of fires, dishwashing, bedmaking, food preparation, and care of the house, were the homemaking activities with which about one-third or more of the homemakers received help (table 32). Less than 15 per cent of the homemakers received help with special house-cleaning, food preservation, sewing, and marketing and account-keeping.

Individual tasks were more often done by homemakers alone or by homemakers and helpers, than by helpers alone. Tasks done alone by at least 80 per cent of the homemakers, were marketing and account-keeping, sewing, mending, food preservation, baking, and special house-cleaning. Tasks on which the helpers alone made an outstanding contribution, were packing lunch pails and care of fires. Tasks carried on by the homemaker and helpers together in 50 per cent or more of the households, were care of the house, dishwashing, and food preparation. The number of households in which a task was done entirely by helpers was relatively small for all activities, except for care of fires; in 71 households the helpers did this entirely.

No single activity was done by the homemaker alone in all homes (table 33). According to these records, the homemaker herself was responsible for nearly all of the care of individual family members. Most of the time used for preparation of food, daily care of the house, and care of clothing, was contributed by the homemaker herself. The time spent

TABLE 32. NUMBER OF HOUSEHOLDS WHERE HOMEMAKERS, HELPERS, OR BOTH, SPENT TIME ON VARIOUS HOMEMAKING ACTIVITIES DURING THE WEEK

(497 farm households in Genesee County, New York, spring, 1936)

Activity	Number of households				Per cent of households			
	Homemaker alone	Helpers alone	Homemaker and helpers	Total	Homemaker alone	Helpers alone	Homemaker and helpers	Total
Food preparation	250	1	246	497	50	..*	50	100
Care of house	123	2	372	497	25	..*	75	100
Dishwashing	210	12	275	497	42	3	55	100
Preparing breakfast	391	27	79	497	79	5	16	100
Preparing dinner	347	10	140	497	70	2	28	100
Preparing supper	352	20	125	497	71	4	25	100
Bedmaking	311	30	156	497	63	6	31	100
Daily care of house	373	12	110	495	75	3	22	100
Washing breakfast dishes	313	49	130	492	64	10	26	99
Washing dinner dishes	274	23	187	484	56	5	39	97
Baking	389	15	76	480	81	3	16	97
Weekly house-cleaning	317	39	123	479	66	8	26	96
Care of fires	187	71	217	475	39	15	46	96
Washing supper dishes	219	42	207	468	47	9	44	94
Washing	325	18	117	460	71	4	25	93
Ironing	348	41	68	457	76	9	15	92
Mending	367	23	49	439	84	5	11	88
Packing lunch pails	180	35	20	235	77	15	8	47
Care of individual family members	140	10	31	181	77	6	17	36
Marketing and account-keeping	162	2	2	166	98	1	1	33
Sewing	114	8	6	128	89	6	5	26
Special house-cleaning	86	1	19	106	81	1	18	21
Upkeep of house	30	0	16	46	65	0	35	9
Food preservation	19	0	4	23	83	0	17	5

*Less than 0.5 per cent.

TABLE 33. APPROXIMATE PERCENTAGE OF TOTAL TIME USED DURING THE WEEK FOR VARIOUS HOMEMAKING ACTIVITIES WHICH WAS CONTRIBUTED BY THE HOMEMAKER

(497 farm households in Genesee County, New York, spring, 1936)

Activity	Per cent of week's total time contributed by the homemaker
Food preservation	96
Care of individual family members	93
Baking	91
Daily care of house	88
Mending	88
Food preparation	87
Preparing breakfast	86
Preparing dinner	86
Making clothes	86
Preparing supper	84
Care of clothing and household linens	83
Packing lunch pails	83
Ironing	82
Washing	81
Care of house	78
Weekly house-cleaning	77
Special house-cleaning	77
Washing dinner dishes	77
Bedmaking	75
Washing breakfast dishes	74
Dishwashing	73
Care of fires	68
Washing supper dishes	65
Upkeep of house	64

by the homemaker on dishwashing was less than three-fourths of the total time spent on this task.

As the amount of help received during the week increased, the percentage of time contributed by the homemaker to homemaking activities decreased (table 34). The time used by the homemaker did not change much, as the amount of help received increased, until the help received amounted to more than 16 hours during the week, after which the homemaker's time decreased materially. Most of these households were the larger households where there were young children and therefore more work to be done; but there were more persons to do the work.

TABLE 34. AMOUNT OF HELP RECEIVED DURING THE WEEK, AND TIME USED FOR HOMEMAKING BY THE HOMEMAKER

(478 farm households in Genesee County, New York, spring, 1936)

Minutes used during the week by helpers	Number of households	Minutes used by the homemaker	Per cent of the week's total time contributed by the homemaker
0	83	3,200	100
1–244	122	3,180	96
245–484	77	3,297	89
485–724	42	3,334	84
725–964	38	3,133	78
965 or more	116	2,769	57
All households	478	3,107	83

Homemakers with children less than 1 year old received almost twice as much help during the week as did the average homemaker (table 35). In families with older children the homemaker received less help than in families where there were very young children. There was little difference in the amount of help received after the youngest person had reached the age of 10 years.

TABLE 35. AGE OF THE YOUNGEST PERSON IN THE HOUSEHOLD, AND TIME USED DURING THE WEEK BY HELPERS FOR ALL HOMEMAKING ACTIVITIES

(471 farm households in Genesee County, New York, spring, 1936)

Age of youngest person (years)	Number of households	Minutes used by helpers
Less than 1	22	1,271
1–5	89	918
6–10	65	754
11–15	82	640
All households	471	653

The amount of help received during the week by the homemaker did not seem to be related to the age of the homemaker.

If there was another woman in the household, the homemaker received about four times as much help during the week as in households where the homemaker was the only woman over 14 years of age.

Assuming that all persons in the same household accomplish the same amount of work in a given length of time, the time used by the homemaker for homemaking was divided by the time used by all workers, and the percentage contributed by the homemaker was thus obtained. The homemaker's time was 90 per cent or more of the total time used for homemaking activities in half of the homes (table 36). It was not usual for the homemaker to have much help, but there was a wide range in the percentage of homemaking time contributed by the homemaker. The average percentage of total homemaking time accounted for by the homemaker's time was 83. The homemaker's time accounted for an average of 93 per cent of the homemaking time in the households of two persons, and 75 per cent in the households of eight or more persons.

TABLE 36. DISTRIBUTION OF HOUSEHOLDS ACCORDING TO PERCENTAGE OF TOTAL TIME FOR HOMEMAKING CONTRIBUTED BY THE HOMEMAKER
(437 farm households in Genesee County, New York, spring, 1936)

Per cent of time contributed by the homemaker	Number of households	Per cent of households	Cumulative per cent
Less than 50	27	6	6
50–59	24	5	11
60–69	33	8	19
70–79	48	11	30
80–89	80	19	49
90–99	149	34	83
100	76	17	100
All households	437	100	XXX

In the households where the homemaker was responsible for a larger share of the homemaking, there were fewer other women over 14 years of age. In the households where the homemaker's time was less than 50 per cent of the total homemaking time for the week, the homemaker had been ill for an average of 1 day during the past week, as compared with 0.2 day in all households. The number of girls from 6 to 14 years of age, and the percentage of homemaking time accounted for by the homemaker, were not closely related, although more help was received in the households where there were two or more girls in this age group.

The homemakers whose homemaking time was less than 50 per cent of the total time for homemaking spent an average of 24 hours during the week, or 3½ hours during the day, on homemaking (table 37); whereas those whose homemaking time was 80 per cent or more of the total homemaking time spent an average of about 8 hours during the day for home-

TABLE 37. PERCENTAGE OF TOTAL TIME FOR HOMEMAKING CONTRIBUTED BY THE HOMEMAKER, AND TIME USED FOR ALL HOMEMAKING ACTIVITIES
(440 farm households in Genesee County, New York, spring, 1936)

Per cent of homemaking time contributed by the homemaker	Number of households	Hours used during the week
Less than 50	28	24
50–59	24	43
60–69	33	55
70–79	48	49
80–89	81	54
90–99	150	56
100	76	54
All households	440	52

making. In the households where the homemaker's time was less than 50 per cent of the total homemaking time, all workers spent an average of 65 hours during the week for certain homemaking activities (table 38); whereas in the households where the homemaker did all of the homemaking, the average time used for these certain homemaking activities was 49 hours during the week.

TABLE 38. PERCENTAGE OF TOTAL TIME FOR HOMEMAKING CONTRIBUTED BY THE HOMEMAKER, AND TIME USED BY ALL WORKERS FOR CERTAIN HOMEMAKING ACTIVITIES

(435 farm households in Genesee County, New York, spring, 1936)

Per cent of homemaking time contributed by the homemaker	Number of households	Hours used during the week by all workers for certain homemaking activities*
Less than 50	27	65
50–59	24	70
60–69	33	75
70–79	48	59
80–89	80	59
90–99	149	55
100	74	49
All households	435	58

*These activities constituted most of the homemaking activities. They were meal preparation, baking, packing lunch pails, routine care of the house, bedmaking, care of fires, dishwashing, washing, ironing, mending, and care of individual family members.

The homemakers who were 30 to 59 years of age contributed a larger percentage of the total homemaking than did the homemakers who were either younger or older.

FARM WORK AND OTHER WORK

In addition to the homemaking activities, for which all homemakers used some time during the week and an average of 8 hours during the weekday, farm work and other work were engaged in.

Approximately 80 per cent of the homemakers reported some time spent on farm work every day (table 39). The average time used was

TABLE 39. TIME USED BY THE HOMEMAKER FOR WORK

(497 farm homemakers in Genesee County, New York, spring, 1936)

Work by the homemaker on the weekday and during the week	Homemakers reporting		Average minutes used		Quartile coefficient of variability per homemaker reporting
	Number	Per cent	Per homemaker	Per homemaker reporting	
On the weekday:					
Homemaking	497	100	493	493	24
Farm work	393	79	69	88	106
Other work	118	24	34	142	78
During the week:					
Homemaking	497	100	3,115	3,115	19
Farm work	400	80	410	515	88
Other work	149	30	120	399	93

about 1 hour during the day for all homemakers, and 1 hour and 28 minutes for those homemakers who reported doing farm work. The time used for farm work was one of the most variable factors studied. Types of farm work engaged in varied from washing milk dishes and churning butter for sale, to doing chores and heavy work in the fields. About 64 per cent of the women washed milk dishes. The women who used 20 hours or more for farm work during the week, used about 7 hours less for homemaking during the week and 1 hour less for other work than did the women using less time for farm work.

Less than one-third of the homemakers engaged in some work other than farm work and homemaking (table 39). There was some disagreement between the time used on the weekday preceding the interview, which averaged 34 minutes, and the time used during the week, which averaged 120 minutes. Perhaps this is another of the activities which were frequently forgotten by the homemakers.

The time used for other work was extremely variable. Included in "other work" were full-time gainful occupations such as teaching school, as well as such part-time activities as gardening and care of pets. Of the different activities included in "other work", more women reported gardening and care of the grounds than any other group of activities, but more time was used for gainful occupations. The women having a gainful occupation used an average of about 14 hours during the week for this activity, which is about a one-third-time job.

During the preceding year, 182 of the homemakers had some gainful

TABLE 40. CASH INCOME EARNED BY HOMEMAKERS DURING THE PAST YEAR
(497 farm homemakers in Genesee County, New York, spring, 1936)

Source of income	Number of homemakers*	Average amount earned
Sale of poultry and eggs	36	$181
Sale of cheese, butter, cream, milk	24	207
Taking boarders or roomers or tourists	22	293
Housework or washing	16	106
Picking vegetables or fruits	10	34
Work in canning factory	10	58
Sewing or dressmaking	9	22
Writing for newspaper	8	35
Teaching school	8	345
Sale of food	8	69
Cleaning schoolhouse	7	26
Nursing	5	160
Papering	4	...‡
Census-enumerating	4	...‡
Raising cats or dogs	4	...‡
Work in cold-storage warehouse	3	...‡
Work on election board	3	...‡
Operating tearoom or cafeteria	3	...‡
Other work†	36	144
Total number earning cash income	182	$172
Total number not earning cash income	315	....
Total homemakers	497	$ 53

*Some homemakers reported more than one source of income.

†Includes: acting as school trustee (2); transporting school children (2); writing (2); magazine agency (2); bean factory (2); apple-drying (2); clerking in store (2); giving music lessons (2); care of grandson; tax collector; town clerk; town welfare officer; juvenile grange deputy; grange secretary; reseating chairs; washing dairy utensils; selling Christmas cards; organist and choir director; selling vegetables; clothing leader; office work; working in veterans' hospital; conducting roadside stand; cutting potatoes; working at county farm; agent; hairdressing; operating gas station; working in shoe factory; working in Jello factory.

‡Less than 5 homemakers reported the amount earned.

occupation and supplemented the family income with average cash earnings of $172 (table 40). The highest amount earned by any one homemaker was $1500. There were 48 different types of occupations reported. Some of these sources of income were indirectly connected with the farm business, such as sales of surplus milk and cream, churning and selling butter, and raising chickens or selling eggs. However, the product would not have been available without the homemaker's labor.

ALL WORK, INCLUDING HOMEMAKING

The homemaker's total work-time for one week averaged nearly 61 hours (table 41). The time used by the homemaker for working tended to increase as the number of persons in the household increased; most of the increase was due to more time being used for homemaking activities. The total work-time also increased as the number of children in the household increased, largely because of an increase in homemaking time. The time used for farm work and for other work was not related to either the number of persons or the number of children in the household. In households where there were children, the children might have done some of the farm and other work.

TABLE 41. NUMBER OF PERSONS IN THE HOUSEHOLD, AS RELATED TO TIME USED DURING THE WEEK BY THE HOMEMAKER FOR WORKING
(497 farm homemakers in Genesee County, New York, spring, 1936)

Number of persons in household	Number of homemakers	Minutes used for all work	Per cent of time used for–			
			Homemaking	Farm work	Other work	Total
2	75	3,195	83	11	6	100
3	110	3,365	82	16	2	100
4	111	3,709	87	11	2	100
5	85	3,594	86	9	5	100
6	43	3,549	86	11	3	100
7	36	4,049	88	10	2	100
8 or more	37	4,554	90	8	2	100
All homemakers	497	3,644	86	11	3	100

TIME NOT SPENT IN WORKING

Personal activities

The homemakers usually slept and rested for nearly 9 of the 24 hours a day (table 42). There was practically no variation in the time used for sleeping and resting.

The time used for eating meals varied slightly more than did the time for sleeping and resting, but most of the homemakers used about 1 hour and 20 minutes during the day for eating. The time spent at the table talking to family members was included in this category.

The homemakers reported relatively little time used for personal care, about 40 minutes during the day, or more than 4 hours during the week. Personal care included dressing, undressing, and other care of the person.

There were 19 homemakers who reported that they either had been ill

TABLE 42. TIME USED BY THE HOMEMAKER FOR PERSONAL ACTIVITIES
(497 farm homemakers in Genesee County, New York, spring, 1936)

Personal activities on the weekday and during the week	Homemakers reporting		Average minutes used		Quartile coefficient of variability per homemaker reporting
	Number	Per cent	Per homemaker	Per homemaker reporting	
On the weekday:					
Sleeping and resting	497	100	530	530	9
Eating meals	497	100	79	79	19
Personal care	497	100	39	39	50
During the week:					
Sleeping and resting	497	100	3,666	3,666	8
Eating meals	497	100	551	551	20
Personal care	497	100	251	251	45
Care of health or illness	19	4	17	488	150

during the week or had used some time for seeing the doctor or the dentist. The time used averaged only 17 minutes for all homemakers, but was more than 8 hours during the week for the homemakers reporting. If this can be taken as representative, the average homemaker is ill about 16 hours each year.

Leisure activities

Fancy-work was included as a leisure activity, although the product might have been used in house-furnishing. Less than one-fifth of the homemakers had spent any time during the week for fancy-work, but 9 per cent had used some time on the weekday preceding the interview (table 43). The time used during the week averaged 1 hour for all homemakers, and 5½ hours for the homemakers who reported doing fancy-work. The time used during the week for fancy-work was extremely variable, perhaps because some homemakers used time for it only once or twice during the week and others used time for it every day.

TABLE 43. TIME USED BY THE HOMEMAKER FOR LEISURE ACTIVITIES
(497 farm homemakers in Genesee County, New York, spring, 1936)

Leisure activities on the weekday and during the week	Homemakers reporting		Average minutes used		Quartile coefficient of variability per homemaker reporting
	Number	Per cent	Per homemaker	Per homemaker reporting	
On the weekday:					
Fancy-work	47	9	10	115	42
Community activities	49	10	22	233	50
Miscellaneous activities	456	92	172	188	50
During the week:					
Fancy-work	95	19	59	330	100
Community activities	107	22	60	289	57
Miscellaneous activities	472	95	932	984	54

There were 10 per cent of the homemakers who had engaged in some community activities on the weekday preceding the interview, and 22 per cent reported some time used during the preceding week (table 43). The average time used for community activities during the week was 1 hour for all homemakers and about 5 hours for the homemakers reporting.

Half of the homemakers said they usually attended meetings of less than three organizations. One-fifth of the homemakers attended no organization meetings, and 94 per cent attended meetings of five organizations or less.

More of the women 35 to 54 years of age attended organization meetings than of those who were younger or older. The number of children less than 16 years of age in the household did not seem to be related to the number of organization meetings that the homemaker usually attended; but the women who had children less than 5 years of age in the household attended fewer organization meetings than did the women with older children. Apparently, after the children start to school they do not interfere with the mother's attendance at meetings.

Miscellaneous activities consisted chiefly of leisure occupations, such as reading, listening to the radio, and visiting. However, since some of the activities that were included, such as playing with children, might not be considered leisure by the homemaker, this group of activities was called miscellaneous. Nearly all (95 per cent) of the homemakers reported some time used for miscellaneous activities during the week (table 43). The average time used for miscellaneous activities was about 3 hours during the weekday and about 16 hours during the week. The average time spent on the weekday preceding the interview may be more nearly accurate than the week's average, and by this criterion an average of about 21 hours during the week was used for miscellaneous activities.

One-third of the homemakers had had a vacation during the past year. Half of these had had one week or more. For the homemakers who were less than 30 years of age and for those who were more than 69 years of age, the percentage who had had a vacation was higher than the average.

As the number of persons in the household increased, the time used for activities other than work decreased. There was no change in time spent on personal care or in eating meals. The time used for sleeping and resting, fancy-work, community activities, and miscellaneous activities decreased.

As the number of children in the household increased, the time used for leisure and personal activities decreased, the greatest decreases being in fancy-work, miscellaneous activities, and sleeping and resting. The time used for personal care, for eating meals, and for community activities did not seem to be related to the number of children in the household.

TIME USED FOR HOMEMAKING ACTIVITIES

While the time used for homemaking activities by the homemakers varied widely, the average was 52 hours for the week (table 13, page 19).

FOOD PREPARATION[11]

Food preparation accounted for more of the homemaker's time than did any other of the homemaking activities except care of the house, which accounted for approximately the same amount of time; 32 per cent of the homemaker's time spent on homemaking activities was used for food preparation. Preparing dinner accounted for one-third of the time used by the homemaker for food preparation, and preparing the three meals accounted for three-fourths of the time.

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[11] In this study, the time spent on food preparation included the time used for preparing and serving the food currently consumed by the family. The time used for preserving and canning food was recorded under *food preservation* instead of *food preparation*, because most of this food was for future consumption.

One-half of the homemakers used between 13 and 20 hours during the week for food preparation. The average time was 16½ hours during the week, or about 2¼ hours a day.

Practically all of the homemakers had spent some time in the preparation of breakfast, dinner, and supper on the day preceding the interview (table 44). Help in preparing meals was received by the homemakers to the extent of about 2 hours during the week, most of which was for preparing dinner and supper. These were also the meals for which the largest number of homemakers received help. The tendency was for the homemakers to prepare only one large meal a day; of the homemakers who used less than average time for preparing supper, 57 per cent used more than average time for preparing dinner; of the homemakers who used more than average time for preparing supper, only 38 per cent used more than average time for preparing dinner.

TABLE 44. TIME USED FOR FOOD PREPARATION
(497 farm households in Genesee County, New York, spring, 1936)

Food preparation on the weekday and during the week	Households reporting		Average minutes used		Quartile coefficient of variability per household reporting
	Number	Per cent	Per household	Per household reporting	
Homemaker, on the weekday:					
Any food preparation	492	99	138	139	27
Preparing breakfast	464	93	23	24	38
Preparing dinner	455	92	44	48	30
Preparing supper	449	90	33	37	25
Packing lunch pails	184	37	5	15	17
Baking	223	45	28	62	50
Homemaker, during the week:					
Any food preparation	496	100	982	984	18
Preparing breakfast	470	95	162	171	33
Preparing dinner	487	98	345	352	25
Preparing supper	477	96	231	241	29
Packing lunch pails	200	40	31	77	33
Baking	465	94	197	210	42
Helpers, during the week:					
Any food preparation	247	50	151	...*	..*
Preparing breakfast	106	21	25	120	45
Preparing dinner	150	30	54	180	88
Preparing supper	145	29	46	156	54
Packing lunch pails	55	11	7	59	50
Baking	91	18	19	106	56

*Not calculated.

The homemakers who had lunch pails to pack, spent, on an average, 15 minutes a day for 5 days of the week; but for the group as a whole, packing lunch pails represented only 3 per cent of the time devoted to food preparation.

In only 3 per cent of the households had no baking been done during the preceding week. The time used by homemakers for baking varied more than did the time used for any other part of the food-preparation process. In nearly all of the households, cake had been baked during the week; and in more than half of them, pie, cookies, and bread had been baked. In a few households, doughnuts and rolls had been made. An average of eight loaves of bread were baked during the week by the homemakers who baked their own bread. At 80 per cent of the homes a baker's wagon came by the door, but not all of these homemakers bought baked goods. About 75 per cent of the homemakers said they used homemade cookies entirely, 38 per cent said they used baker's bread entirely, and 35 per cent said they used homemade bread entirely.

The percentage of time used for food preparation by the homemaker in preparing breakfast and dinner decreased as the total time used for food preparation increased, the percentage used for supper and for other food preparation remained about the same, and the percentage used for baking and for packing lunch pails increased rapidly.

Variation in time used for food preparation

The time used for food preparation by the homemaker and by all workers was closely associated with the number of persons in the household. The time used by all workers for meal preparation, baking, and packing lunch pails increased as the number of persons in the household increased. The amount of work to be done in preparing food can be roughly measured by the number of persons for whom food is to be prepared.

As the number of persons in the household increased, the time used during the week by the homemaker for all parts of the food-preparation process, except preparing dinner, tended to increase. The largest actual increase was in baking, and the largest proportionate increase was in packing lunch pails. The time used per capita for all parts of the food-preparation process, except packing lunch pails, decreased as the number of persons in the household increased. The largest actual decrease was in time used for preparing dinner.

The number of meals[12] served was closely associated with the number of persons in the household. As the number of meals served during the week increased, the time used by all workers for meal preparation increased; but the time used for preparing individual meals decreased from an average of 16 minutes per person per meal, in households serving two persons, to 5 minutes in households serving nine or more persons (appendix, table 69, page 90).

Apparently, less time was required for preparing meals for a young child than for an adult. As the age of the youngest person and the number of persons in the household increased, the time used for food preparation increased; the largest increases seemed to be due to increases in the number of persons in the household.

There was relatively little difference in the time used for food preparation in the households reporting different kinds of cooking fuel.

In the homes where there was running water, slightly more time was used during the week for food preparation than in the homes where there was no running water. This seems paradoxical; but the saving which might be due to having running water, may be small in comparison with the effect of other factors such as arrangement of the equipment used in food preparation, number of meals served, and number of different dishes prepared.

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[12] An individual meal was considered to be one meal served to one person at home.

There were 61 per cent of the families who usually ate three meals a day in the kitchen. Since 29 per cent usually ate no meals in the kitchen, in at least 71 per cent of the houses the kitchen was large enough to provide a dining center for some of the meals. As the number of persons in the household increased, the percentage of meals eaten in the kitchen decreased. In the households where all the meals were eaten in the dining-room, about the same amount of time was spent during the week on food preparation as in the households where all the meals were eaten in the kitchen. Serving the food was included in food preparation; but apparently any saving in time which might have been expected because of having the meals eaten in the kitchen was too small to show, or else too many other factors entered into the time used for food preparation.

In an attempt to construct a measure for comparing the amount of baking done in each household, the number of different foods baked and the number of articles baked were tested. The number of articles baked seemed, from preliminary tests, to be more closely related to the time used for baking than did the number of different kinds of food baked. The following were considered as each representing one article: one cake, one pie, one loaf of bread, one dozen cookies, one dozen rolls, one dozen friedcakes. As the number of articles baked increased, the time used for baking increased at a decreasing rate (appendix, table 70, page 90).

As the number of lunch pails packed increased, the time used for this purpose increased (appendix, table 71, page 91).

DISHWASHING[13]

Dishwashing is one of the routine activities of homemaking that are frequently considered disagreeable but are not considered physically fatiguing.

Dishwashing accounted for 14 per cent of the time used by the homemaker for homemaking activities. About the same amount of time was used by the homemaker during the week for washing breakfast dishes as for washing supper dishes; more time was used for washing dinner dishes (table 45).

Practically all of the homemakers had washed dishes during the week, and more than half of them had had some help. The largest number of homemakers had had help on supper dishes. The homemakers used an average of about 7 hours during the week for dishwashing, and had an average of nearly 3 hours of help.

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[13] The time used for dishwashing included the time used for clearing the table and washing the breakfast, dinner, and supper dishes. Usually, baking dishes, lunch pails, and dishes from any extra meal were washed with the dishes from a regular meal; when they were washed separately, the time used was included in the time used for the dishes from the next meal. When the dishes from two or more meals were combined, as was occasionally done in a few households, no attempt was made to separate the time used for those from each meal, the entire time being credited to the dishes for the meal following which they were washed.

TABLE 45. TIME USED FOR DISHWASHING
(497 farm households in Genesee County, New York, spring, 1936)

Dishwashing on the weekday and during the week	Households reporting		Average minutes used		Quartile coefficient of variability per household reporting
	Number	Per cent	Per household	Per household reporting	
Homemaker, on the weekday:					
Any dishwashing	469	94	61	65	25
Breakfast dishes	422	85	18	22	38
Dinner dishes	403	81	22	27	25
Supper dishes	384	77	19	24	38
Homemaker, during the week:					
Any dishwashing	485	98	434	446	29
Breakfast dishes	443	89	133	150	45
Dinner dishes	461	93	167	180	25
Supper dishes	426	86	135	158	36
Helpers, during the week:					
Any dishwashing	287	58	166	...*	..*
Breakfast dishes	179	36	44	123	59
Dinner dishes	210	42	50	118	78
Supper dishes	249	50	72	143	54

*Not calculated.

As the total time used by the homemaker for dishwashing increased, the time used to wash the dishes for each meal increased, the largest increase being in the time used for washing breakfast dishes.

Variation in time used for dishwashing

As the number of persons in the household increased, the time used by the homemaker for washing the dishes from each meal and the proportion of her time used for washing the dishes from each meal remained about the same. The time used per capita by the homemaker for washing the dishes from each meal and from all meals decreased rapidly as the number of persons in the household increased. The same tendency was found by Henderson (1937).

Although the time used by the homemaker for dishwashing remained about the same, as the number of persons in the household increased, the time used by helpers increased, and therefore the time used by all workers increased (appendix, table 72, page 91). Of the total time used for dishwashing in households of two persons, 5 per cent was done by helpers; but 50 per cent was done by helpers in households of eight or more persons.

As the number of individual meals served during the week increased, the time used during the week by all workers for dishwashing increased.

The number of children in the household was not related to the time used by the homemaker for dishwashing. Washing the dishes for a young child did not seem to require so much time as did washing the dishes for an adult.

In the households that had running water, the same amount of time was used for dishwashing as in the households not having running water. It may be that the time used for dishwashing is so largely affected by the number of individual meals served and the arrangement of equipment for washing dishes, that any saving in time due to having running water is negligible.

In the households where some meals were eaten in the kitchen, less time was used per household for dishwashing but there was no saving in time used per capita. Since the families eating in the kitchen were smaller, it is possible that the saving in time due to the fewer steps necessary in clearing the table when meals are eaten in the kitchen was offset by the longer time per capita taken to wash dishes when the household is small. The kitchens may not have been large enough for the larger households to eat there, making it necessary for them to eat in the dining room even though time might have been saved by their eating in the kitchen.

CARE OF THE HOUSE[14]

Closely following food preparation, care of the house was the most time-consuming homemaking activity of the homemaker, requiring an average of 31 per cent of her time for homemaking activities; but for all workers the time used for care of the house was greater than that used for food preparation. Daily care of the house, weekly house-cleaning, and care of fires accounted for most of the time used for care of the house; one-third of the time was used for daily care.

During the week, nearly all of the homemakers had spent some time on such care of the house as is usually attended to from day to day, on

TABLE 46. TIME USED FOR CARE OF THE HOUSE
(497 farm households in Genesee County, New York, spring, 1936)

Care of the house on the weekday and during the week	Households reporting		Average minutes used		Quartile coefficient of variability per household reporting
	Number	Per cent	Per household	Per household reporting	
Homemaker, on the weekday:					
Any care of house	490	99	157	160	46
Daily care of house	440	89	56	64	50
Weekly house-cleaning	69	14	15	106	44
Special house-cleaning	76	15	26	172	60
Care of fires	397	80	32	40	67
Bedmaking	450	91	13	14	33
Homemaker, during the week:					
Any care of house	495	100	978	982	29
Daily care of house	483	97	372	383	38
Weekly house-cleaning	440	89	187	211	33
Special house-cleaning	105	21	70	334	50
Care of fires	404	81	218	269	74
Bedmaking	467	94	95	101	23
Upkeep of house	46	9	38	411	50
Helpers, during the week:					
Any care of house	374	75	239	...*	..*
Daily care of house	122	25	51	209	77
Weekly house-cleaning	162	33	55	168	63
Care of fires	288	58	102	176	46
Bedmaking	186	37	31	84	50

*Not calculated.

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[14] Daily care of the house included the routine "straightening-up" of the house, daily cleaning, and carrying water, but not bedmaking. Weekly house-cleaning included the cleaning done only once a week; special house-cleaning included the cleaning done only once or twice a year. Care of fires included the time used for tending fires, bringing in fuel, and emptying ashes. Upkeep of the house was separated from special house-cleaning, although usually both were done at the same time; upkeep of the house included time used for papering, painting, and repairing the house, both outside and inside.

bedmaking, and on care of fires (table 46). There were 288, or 58 per cent, of the homemakers who had had some help on the care of fires; this is the largest number of homemakers receiving help on any one homemaking activity.

Since weekly house-cleaning, special house-cleaning, and upkeep of the house were not daily homemaking activities, they were not reported by many homemakers on the weekday preceding the interview. However, nearly all of the homemakers had done some weekly house-cleaning during the week. Only 21 per cent of the homemakers had done any special house-cleaning during the week, and 9 per cent had done some of the tasks classed as "upkeep of the house."

Some of the homemakers said they usually did a part of the weekly house-cleaning each day and included it with the daily care of the house; others said they did the weekly house-cleaning on one or two special days each week. In order to eliminate any differences caused by these different methods when studying factors affecting time used for regular care of the house, the time used for daily care of the house and that used for weekly house-cleaning were combined under the designation "Routine care of the house." Routine care of the house was reported by nearly all of the households; the average time used by all workers was about 11 hours during the week.

Practically all of the homemakers used time during the week for some care of the house. Half of them used between 10 and 20 hours; the average time was about 16¼ hours during the week, or 2 hours and 20 minutes a day. The average time used during the week by helpers was about 4 hours, making a total for all workers of more than 20 hours. The helpers' time was 22 per cent of the total for care of the house.

Variation in time used for care of the house

As the number of persons in the household increased, the time used by the homemaker for care of the house tended to remain about the same but the time used by all workers increased.

The time used by the homemaker for each item under care of the house did not seem to be related to the number of persons in the household, except that the time spent on bedmaking increased and the time spent on special house-cleaning decreased as the number of persons in the household increased. The time used per capita by the homemaker for care of the house decreased as the number of persons in the household increased. The largest proportionate decrease was in daily care of the house.

As the number of rooms requiring daily care increased, the time used for routine care of the house tended to increase (appendix, table 73, page 91). The time used for care of each room decreased from an average of 5½ hours during the week, for less than three rooms, to 1½ hours, for nine or more rooms.

Most of the households consisting of two or three persons reported less than six rooms that required daily care. The number of rooms requiring daily care increased as the number of persons in the household increased; but there were households of six or more persons that reported less than five rooms requiring daily care.

The time used for routine care of the house increased as the size of the household and the number of rooms requiring daily care increased; the number of rooms seemed to be the more important factor.

The time used for bedmaking increased directly as the number of beds increased (appendix, table 74, page 92).

The time used for care of a furnace was about the same as the time used for care of one stove. The time used for care of fires increased as the number of fires kept increased (appendix, table 75, page 92).

The time used by the homemaker for care of the house did not seem to be related to the number of children in the household.

There was no difference in the time used for care of the house between households with and those without running water. The time used for carrying water was included in daily care of the house. Therefore any saving in time because water did not have to be carried, must have been offset by increases in the time used for other items under care of the house.

CARE OF CLOTHING AND HOUSEHOLD LINENS

Care of clothing and household linens included both heavy work such as washing, and light work such as mending. Although washing and ironing are heavy work, they are usually done on only one or two days during the week and so may not consume as much of the homemaker's total energy as do some other homemaking activities which are less strenuous but are done every day. Sewing may be considered a leisure activity; it offers some homemakers an opportunity to express their creative ability as well as to relax while working.

Care of clothing and household linens accounted for only 13 per cent of the time used during the week by the homemaker for homemaking activities. Washing required 40 per cent of the time used by the homemaker for care of clothing; ironing, 30 per cent; mending, 20 per cent; and sewing, 10 per cent.

Nearly all of the homemakers washed and ironed clothes sometime during the week (table 47). The time used by all workers for ironing averaged 1 hour a week less than the time used by all workers for washing.

Mending, like washing and ironing, seemed to be a task usually done on only one or two days of the week.

There were 24 per cent of the homemakers who had done some sewing during the week. If the average time used is representative of all homes, about 40 hours of sewing is done during a year in each home.

Variation in time used for care of clothing and household linens

As the number of persons in the household increased, the time used by the homemakers, by helpers, and by all workers, for care of clothing and household linens, increased. The average time used during the week by the homemakers was nearly 7 hours; all workers used an average of more than 8 hours, of which 16 per cent was given by helpers.

As the number of persons in the household increased, the time used during the week by homemakers for washing, ironing, and mending in-

TABLE 47. TIME USED FOR CARE OF CLOTHING AND HOUSEHOLD LINENS
(497 farm households in Genesee County, New York, spring, 1936)

Care of clothing and household linens on the weekday and during the week	Households reporting		Average minutes used		Quartile coefficient of variability per household reporting
	Number	Per cent	Per household	Per household reporting	
Homemaker, on the weekday					
Washing	99	20	27	134	38
Ironing	92	19	20	110	33
Mending	109	22	13	62	50
Sewing	48	10	8	108	67
Homemaker, during the week:					
Washing	442	89	168	189	33
Ironing	416	84	125	149	38
Mending	416	84	81	97	58
Sewing	120	24	43	191	60
Helpers, during the week:					
Washing	135	27	39	143	50
Ironing	109	22	28	128	38
Mending	72	14	11	78	75
Sewing	14	3	7	267	175

creased, but the time used for sewing showed no consistent change. The time used per capita by the homemaker for washing, ironing, mending, and sewing decreased as the number of persons in the household increased, the greatest decrease being in the time used for ironing.

As the number of children in the household increased, the time used during the week by all workers for care of clothing and household linens tended to increase. The time used for washing showed the most consistent and the largest increase.

The relationship between the age of the youngest person in the household and the time used for washing was somewhat confused, because the households usually were larger where there were young children. Both the age of the youngest person and the number of persons in the household seem to be important factors in determining the amount of time used for washing. The time used for washing increased with the size of the household (appendix, table 76, page 92), and was decidedly higher for households where there were children less than 3 years of age (table 48).

TABLE 48. AGE OF YOUNGEST PERSON IN THE HOUSEHOLD, AS RELATED TO TIME USED DURING THE WEEK BY ALL WORKERS FOR WASHING
(174 farm households in Genesee County, New York, spring, 1936)

Age of youngest person in household (years)	Number of households	Minutes used for washing
Less than 1	26	412
1	4	378
2	33	307
3	16	182
4	19	238
5	11	213
6	15	189
7	9	200
8	17	208
9	5	198
10	19	246

The age of the youngest person in the household did not seem to be related to the time used for ironing.

The time used during the week by all workers for mending decreased as the age of the youngest person in the household increased, the decrease being noticeably large in families in which the youngest person was 10 years of age. There was a tendency for time used weekly by all workers for mending to increase as the size of the household increased (appendix, table 77, page 92).

The time used during the week by all workers for sewing was slightly higher in the households with three or more children than in the households with fewer children.

In an attempt to get some measure of the size of the washing done in each home, the homemakers were asked to list the large articles of clothing washed. In determining the size of the washing, each of the following was counted as one article: one sheet, one shirt, one tablecloth, one dress, one pair of overalls, one suit of heavy underwear, one bedspread, one blanket, one pair of curtains, one rug, two aprons, two child's dresses or suits, three towels. Nightclothes, stockings, handkerchiefs, napkins, diapers, and other smaller articles were omitted. Later study showed that this basis was not close enough to accuracy to be used for comparing the washings as to size. All articles washed should have been listed, but probably this would only have increased the tendencies shown.

As the number of articles washed increased, the time used for washing tended to increase. The average number of articles washed was 22; one-half of the households reported washings varying in size from 16 to 30 articles. The number of articles washed increased with the size of the household.

In an attempt to get some measure of the size of the ironing done in each home, each of the following was considered as one article ironed: one sheet, one dress, one shirt, one tablecloth, one pair of curtains, one bedspread, two aprons, two child's dresses or suits, four towels. Small articles were omitted, and later analysis indicated that they were not so important a part of ironing as of washing. Pressing was not included in articles ironed, and so it was possible to have a household where some time was reported as being used for ironing but no articles were actually ironed.

Most of the households reported between 8 and 17 articles ironed during the week, the average number being 13. The time used during the week for ironing increased with the number of articles ironed (appendix, table 78, page 93).

The time used for ironing doubled, and the number of articles ironed increased 2½ times, as the number of persons in the household increased from two to nine or more.

In the households where an electric washing machine was used, 25 articles were washed during the week, as compared with 16 articles in the households where no washing machine was used (table 49). The time used for washing was least in the households using a gas-engine washing machine, and greatest in the households using a hand-power machine. The time used per article washed was least in the households using a gas-engine washing machine.

TABLE 49. TYPE OF WASHING MACHINE USED, AS RELATED TO WASHING DONE
(499 farm households in Genesee County, New York, spring, 1936)

Type of washing machine used	Number of households	Number of articles washed	Minutes used weekly for washing	Minutes used per article washed	Per cent of households washing during the week
No washing machine	101	16	181	12	82
Hand-power	61	19	224	12	93
Gas-engine	46	22	173	8	87
Electric	291	25	210	9	97

Of the households where there was an electric washing machine, 97 per cent reported doing some washing during the week; only 82 per cent of the households having no washing machine reported doing washing.

The average time used per article ironed was 13 minutes for the households using sadirons and 12 minutes for the households using electric irons; the total time used for ironing was about the same with the two types of irons. Of the households using electric irons, 94 per cent did some ironing during the week, as compared with 86 per cent of the households using sadirons. In the households where an electric iron was used, the median number of articles ironed was 13; in those where a sadiron was used, the median was 10 articles.

Laundry delivery service

Although laundry delivery service was available to about half of the homes, only 7 per cent of them ever sent laundry out. There were 70 homemakers who had not bothered to find out whether laundry delivery service was available or not. Of the homemakers for whom the service was available, 13 per cent sent some laundry out, as compared with 4 per cent of the homemakers who did not have the service. As delivery service becomes more available, it is possible that laundry work will be done in fewer homes.

OTHER HOMEMAKING ACTIVITIES

Care of members of the household[15]

The time used for care of members of the household can vary widely, depending on how well the physical needs are met and how much additional time is used in teaching a child to be independent. Mothers with young children frequently say that their housework suffers if they do all they wish to do in caring for the children.

The time used for care of members of the household accounted for only 7 per cent of the average homemaking time used by all homemakers during the week; but in the households having children the average amount of time used during the week was about 12 hours; in 36 households, more than 18 hours was used by all workers during the week. Only about one-third of the homemakers used any time weekly or daily for care of members of the household (table 50). This was one of the most variable factors of all the homemaking activities studied.

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[15] Time spent in caring for children and invalids was included, but time spent in playing with children was not.

TABLE 50. TIME USED FOR OTHER HOMEMAKING ACTIVITIES
(497 farm households in Genesee County, New York, spring, 1936)

Other homemaking activities on the weekday and during the week	Households reporting		Average minutes used		Quartile coefficient of variability per household reporting
	Number	Per cent	Per household	Per household reporting	
Homemaker, on the weekday:					
Care of individual family members	161	32	31	102	77
Marketing and account-keeping	97	20	32	166	30
Homemaker, during the week:					
Care of individual family members	171	34	221	669	73
Marketing and account-keeping	164	33	76	235	50
Food preservation	23	5	12	260	67
Helpers, during the week:					
Care of individual family members	41	8	22	...*	..*
Marketing and account-keeping	4	1	...*	...*	..*
Food preservation	4	1	...*	...*	..*

*Not calculated.

As the age of the youngest person in the household increased, the time used for the care of members of the household decreased (appendix, table 79, page 93). In households where the youngest person was an infant, 25 hours a week were used for care of the family. If this were all done by the homemaker, it would be about 15 per cent of her total time or about one-fourth of her waking time. Where the youngest person in the household was 1 to 3 years of age, about 16 hours a week were used. The time used decreased steadily until the youngest person was about 9 years of age, when there was a drop from about 3 hours during the week to 1 hour. The large decreases occurred after 1, 3, and 8 years of age. This held true whether there was one child or more in the household.

Nearly all of the evidence indicated that where there was one child, about the same amount of time was used as where there were two or more children of about the same age, and so less time must have been used for each child. Perhaps where there was more than one child, the older child helped the younger ones and that child's time was not properly estimated by the homemakers; or, in helping two children to eat, dress, and the like, about the same time is used as for one child.

The time used was not influenced by the number of persons in the household, if all household members were in good health and there were no young children. This was the only homemaking activity in which the percentage of the total time which was accounted for by helpers did not seem to be related to the number of persons in the household.

Teaching the child certain routine activities

Because of the fact that the time used for care of individual family members was extremely high in the households where there was a very young child, it was thought advisable to make a detailed study of teaching the child certain routines. If, as a result of learning these routines, the child can care for himself, the mother's time can be freed for other activities and the child does not form the habit of depending on the adult for help.

From mothers of pre-school children, 97 records were obtained telling when the mother started to teach the child certain routines, how much time the mother used daily at the beginning of the learning period, and the age at which the child could perform the activity with supervision and without supervision. The routine activities studied were: drinking from a cup; eating with a spoon; eating with a fork; using a knife; putting on underwear; putting on and lacing shoes; putting on outerwear; putting on wraps; putting on rubbers and galoshes; dressing completely; keeping dry during the day; undressing; keeping dry at night; brushing teeth; washing; bathing; going to bed alone at night; going alone for a nap. In general, the mothers stated the ages for the learnings at six-months intervals; that is, at six, twelve, or eighteen months. Most of the children for whom records were obtained were 2 to 5 years of age.

The median age at which homemakers started teaching their children to drink from a cup was nine months; for eating with a spoon, twelve months; for eating with a fork, eighteen months; for keeping dry during the day, twelve months; and for undressing and for brushing teeth, thirty months (table 51). The median learning period was about six months for all these routine activities except undressing, for which the median learning period was twelve months. In general, the children learned first to drink from a cup; next, to eat with a spoon and then with a fork, and to keep dry during the day; and finally, to brush their teeth and to undress themselves. At the beginning of the learning period, the time spent by the mother for teaching was usually 20 minutes or less daily; for keeping dry during the day, the median time used for teaching was 1 hour daily.

TABLE 51. TEACHING THE CHILD CERTAIN ROUTINE ACTIVITIES
(87 mothers with pre-school children in Genesee County, New York, spring, 1936)

Routine activity	Age when teaching was started	Learning period	Age at which child could accomplish–		Median daily minutes for teaching at the beginning
			With supervision	Without supervision	
	Median months				
Drinking from a cup	9	6	12	14	15
Eating with a spoon	12	5	15	18	20
Eating with a fork	18	6	24	24	15
Keeping dry during day	12	7½	20½	24	60
Undressing	30	12	36	42	10
Brushing teeth	30	6	36	39	5

In general, if the mother started to teach the child a routine at less than the median age, the child learned to do it at less than the median age. This seemed to be true for all routines for which sufficient data for determining this point were available. The learning period was usually shorter for the children who were older before the teaching was started, than for the children who were young when the teaching was started, which might have been accounted for by physical maturation. More of the children whose mothers started teaching them when they were older than the median, learned in less than four months. The child's interest in learning a skill may be greater at certain ages, and may be important in fixing the time required for teaching.

The earliest age at which a mother started teaching her child these routines was always much younger than the median age. The earliest age at which any child learned to carry through any of these routines was sometimes as much as two or more years younger than the median.

The correlation between the age at which the mother started teaching the child, and the learning period, was always low and was usually negative. This is to be expected, because the older the child is when the mother starts teaching, the sooner he will be physically capable of being independent. The correlation between the age at which the mother started teaching, and the age at which the child learned, was positive and usually was fairly high.

Marketing and account-keeping

None of the homemakers said they used time for planning. Since many of them said, however, that they planned their work, the planning must have been done while they were engaged in other activities. Marketing and account-keeping, which would be associated with planning, represented only 3 per cent of the time used during the week by the homemakers for homemaking activities. Time used for shopping, either in town or through salesmen who came to the house, was included in marketing.

Only one-third of the homemakers had used any time during the week for marketing and account-keeping (table 50, page 50). The average time used was 1¼ hours during the week for all homemakers, and nearly 6 hours for the homemakers who reported any time used. Marketing and account-keeping was not listed on the survey blank, and frequently may have been omitted from the record owing to the enumerator's not having asked the question or the homemaker's not having remembered the time used. This is partly confirmed by the larger percentage of homemakers reporting in the other three seasons of the year, when a definite effort was made to record the time used for this task. Only 4 homemakers said they received help in this task, but many homemakers said later in the interview that their husbands did much of the food-purchasing. For these reasons, probably both the average amount of time used by all workers for this task, and the amount of help received, are inaccurate as presented here.

There were 82 homemakers, or 16 per cent of the total number, who said they kept household accounts of some sort, although some said the accounts were sketchy. In addition, 4 homemakers kept only food accounts. In some households the husband kept most of the household accounts. Frequently the farm and the household accounts were kept together.

Only 8 per cent of the households did not have a car. There were 48 per cent of the homemakers who had a driver's license, which represents slightly more than half the number of households where there were cars. Of the homemakers who had a driver's license, 15 per cent did not drive to town regularly. Of all the homemakers, 85 per cent said they liked to shop.

One-half of the homemakers said they usually did all of the food-purchasing for the household, and one-fifth of them said they usually did none of the food-purchasing. About two-thirds of the husbands ordinarily did no food-purchasing and one-third did some; 13 per cent did all of it. Of the other household members, 84 per cent usually did no food-purchasing and 7 per cent did all of it.

The time used for marketing and account-keeping was not related to the number of persons in the household, but it was slightly less in households where there were children than in households of adults. Probably it takes no longer to buy the food for a large household than for a small household, and most of the marketing was food-purchasing. The homemaker who has young children may delegate the responsibility for marketing to other household members.

Food preservation[16]

Since the records were taken in the late spring, not much time was used for food preservation; only 5 per cent of the homemakers had preserved any food during the week preceding the interview (table 50, page 50). The homemakers preserving food used an average of more than 4 hours during the week for the process, most of which was for the canning of meat. Only 4 of the homemakers said they had received help on food preservation.

VARIATION IN TIME USED, DUE TO DAY OF THE WEEK

HOMEMAKING ACTIVITIES

For all homemaking activities, the most time was used on Monday and on Saturday. The time used each weekday for all food preparation varied, largely because of variations in time used for packing lunch pails and for baking. Lunch pails were packed each weekday except Saturday in about the same number of homes (table 52). The largest number of homemakers reporting baking, and the most time used for baking, were on Thursday and Saturday. The smallest number of homemakers reported baking on Monday. Fewer homemakers reported preparing dinner on Tuesday, but the time used did not vary significantly.

There was little variation in the percentage of homemakers washing dishes each weekday.

The time used for care of the house was higher on the days when weekly or special house-cleaning was done. Weekly house-cleaning was most frequently done on Friday or Saturday—although there seemed to be a slight tendency for some women to clean on Monday, perhaps clear-

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[16] The time used for food preservation was not included in the time used for food preparation, because the product is usually consumed during a period of several weeks, and food prepared during the week is usually consumed in that same week. Canning, making jellies and jams, and butchering were classified as food preservation.

TABLE 52. RELATION OF DAY OF THE WEEK FOR WHICH RECORD WAS TAKEN, TO PERCENTAGE OF HOMEMAKERS DOING VARIOUS ACTIVITIES
(499 farm homemakers in Genesee County, New York, spring, 1936)

Activity	Day of the week for which record was taken						
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	Per cent of homemakers reporting*						
Food preparation	99	99	98	99	100	100	98
Preparing breakfast	94	92	95	93	93	94	93
Preparing dinner	96	87	79	93	95	97	91
Preparing supper	92	92	92	87	91	94	91
Packing lunch pails	..†	40	44	35	34	41	27
Baking	..†	30	44	40	50	47	70
Dishwashing	97	95	93	96	96	91	89
Breakfast dishes	86	86	77	91	88	82	80
Dinner dishes	87	76	79	82	87	82	80
Supper dishes	77	84	74	74	76	76	79
Care of house	98	98	97	99	99	100	100
Daily care of house	54	84	86	91	92	88	91
Weekly house-cleaning	0	14	7	12	10	18	34
Special house-cleaning	0	13	16	17	19	21	4
Bedmaking	92	90	88	93	92	94	86
Care of fires	77	85	80	81	75	79	77
Care of clothing and household linens:							
Washing	2	50	16	15	12	3	5
Ironing	..‡	18	34	20	9	21	5
Mending	..‡	14	26	23	23	18	29
Sewing	0	9	10	13	7	12	5
Care of individual family members	23	28	38	30	29	18	36
Marketing and account-keeping	..‡	13	16	22	15	15	43
Fancy-work	2	5	12	10	13	15	4
Community activities	9	5	9	13	12	12	9
Miscellaneous activities	76	91	94	92	92	94	86
Sleeping and resting	100	100	100	100	100	100	100
Any homemaking	100	100	100	100	100	100	100
Farm work	73	77	75	79	84	88	75
Other work	4	17	31	23	30	32	9

*The numbers of homemakers on which the percentages are based are as follows: 499, Sunday; 104, Monday; 97, Tuesday; 104, Wednesday; 101, Thursday; 34, Friday; 56, Saturday.

†Not calculated.

‡Less than 0.5 per cent.

ing up the house after week-end guests. Special house-cleaning was apparently done any day of the week which suited the homemaker, with the exception of Saturday. In taking the records an attempt was made to separate the time used for daily care of the house from the time used for weekly or special house-cleaning. The average time used for daily care of the house was lowest on Tuesday and Friday, and the percentage of homemakers reporting was lowest on Monday.

The largest percentage of women washed on Monday. Much of the washing done on other days seems to have taken little time, being perhaps the daily washing for a small child or personal articles of clothing. The largest percentage of women reported ironing on Tuesday. The largest amount of time reported for mending was on Saturday. Sewing was done by some women each day, but the largest amount of time was used on Friday.

By far the largest percentage of women reported marketing and account-keeping on Saturday, and the most time for this activity was used on Saturday. Apparently, trips to town are made during the week for some shopping, but most of the shopping was done on Saturday.

OTHER ACTIVITIES

Fancy-work was reported by the largest percentage of women on Friday, and by the smallest percentage on Monday and Saturday. The largest average amount of time reported also was on Friday. Community activities were participated in by the largest percentage of women on Wednesday, Thursday, and Friday. About the same amount of time was reported daily for miscellaneous activities.

The least time was used by the homemaker for farm work and other work on Saturday, but the children may have been home from school and able to do this work. The most time was used for other work on Friday.

From these figures it would seem probable that a usual week's schedule for these homemakers might be: washing on Monday; ironing on Tuesday; mending on Wednesday, and perhaps attending some community activity; baking on Thursday, and finishing the ironing or mending if necessary; a part of the weekly house-cleaning on Friday, and some sewing or fancy-work; finishing the weekly house-cleaning, baking, and shopping on Saturday.

ACTIVITIES ON SUNDAY

Sunday did not resemble the other days of the week in the number of homemakers reporting various tasks or in the time used for these tasks. The homemakers used about half as much time for homemaking activities on Sunday as on other days of the week. Meal preparation, dishwashing, and care of the house were done by nearly all of the homemakers on Sunday, but other homemaking activities usually were not reported. The percentage of homemakers caring for individual family members was about the same as the percentage reporting this activity on other days. Only 9 per cent of the homemakers reported any community activities on Sunday, most of these having gone to church. Three-fourths of the homemakers reported that they used some time on Sunday for miscellaneous activities and leisure; probably more of the homemakers had leisure time, but failed to report it. The percentage of homemakers reporting farm work was the same for Sunday as for other days of the week, but the percentage doing other work was lower than on any other day.

The time used for food preparation on Sunday was less than the time used on any other day of the week; the time used for preparing Sunday dinner was more; that for supper was less; that for breakfast was about the same. The time used for packing lunch pails and for baking averaged only 2 minutes for all the homemakers.

The time used by the homemaker for washing dishes on Sunday was about the same as on other days of the week. More time was used for dinner dishes, and less time for supper dishes.

The time used for care of the house on Sunday was less than half the time used on any other day of the week. Most of this time was used for care of fires and daily care of the house.

Practically no time was used on Sunday for care of clothing and household linens, but nearly the same amount of time was used for care of individual family members as on other days.

Less time was used by the homemakers on Sunday for fancy-work, community activities, and miscellaneous activities, than on other days of the week. About the same amount of time was used for personal care and for eating meals, less time was used for farm work, and much less time was used for other work.

VARIATION IN TIME USED, DUE TO SEASON OF THE YEAR[17]

The 47 households from which seasonal records were obtained were similar in composition to the 502 households for which the spring records were analyzed. A much higher proportion of the seasonal records were from farms in land class V, and a lower proportion from farms in land class IV, than of the entire group. The farm classification of the seasonal records tended to be slightly better than that of the entire group.

Among these 47 households there were more persons in the household during the summer (an average of 4.8) and fewer in the winter (an average of 4.4). The extra persons in the summer were: students and teachers who were members of the family and who could be at home during the summer; extra hired men employed during the summer; relatives; and guests. In addition to those persons who were regular members of the household during the week preceding the interview, an average of 3.4 guest meals were served during the week in the spring, 6.5 in the summer, 5.4 in the fall, and 4.3 in the winter.

Food preservation was the most seasonal of all homemaking tasks; practically every homemaker did some canning or jelly-making in the fall and but little in the other seasons (table 53). More women made clothes during the winter than in the other seasons, probably because they had time to sew and there were fewer things to do on the farm or in the community. For the same reasons, more women did fancy-work and mending in the winter. Fewer homemakers packed lunch pails in the summer, because the children were not then in school.

A large number of homemakers did some work in addition to homemaking activities in the summer and the fall, which was the time of year when they took care of the garden and grounds. In farm work, more homemakers took care of chickens in the summer and of eggs in the winter than during the other seasons. More homemakers said they churned in the spring and the summer, and prepared extra meals in the summer, than at other seasons. Among the leisure activities, the largest number of homemakers reported going to church in the summer and the fall, and listening to the radio and reading in the winter. Getting chil-

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[17] From the spring records a list was made of 60 farms where the enumerator felt that the homemaker would be willing to give another interview. In the summer, 60 records were obtained; in the fall, 57; and in the winter, 47. For the study of seasonal variation in the use of time, the 47 records which were complete for all four seasons were used. The summer records were obtained on July 1 to 3, 1936; the fall records, on September 21 to 25, 1936; and the winter records, on February 8 to 10, 1937. The weather was typical during each of the seasons except the winter, which was mild. None of the homemakers mentioned the weather as making a difference in the activities which they carried on during the winter.

TABLE 53. NUMBER OF HOMEMAKERS DOING VARIOUS ACTIVITIES DURING THE PRECEDING WEEK EACH SEASON
(47 farm homemakers in Genesee County, New York, 1936–37)

Activity	Number of homemakers			
	Spring*	Summer*	Fall*	Winter*
Food preparation	47	46	47	47
Preparing breakfast	46	44	45	45
Preparing dinner	45	46	46	46
Preparing supper	45	45	45	46
Baking	46	39	41	43
Packing lunch pails	26	3	19	18
Dishwashing	47	43	47	46
Breakfast dishes	43	40	43	37
Dinner dishes	46	40	47	44
Supper dishes	40	39	40	41
Care of house	47	47	47	46
Daily care of house	47	46	46	45
Weekly house-cleaning	44	42	43	40
Bedmaking	46	45	46	44
Care of fires	35	23	26	34
Special house-cleaning	5	8	4	8
Upkeep of house	5	5	0	2
Care of clothing and household linens:				
Washing	44	41	42	41
Ironing	39	40	41	37
Mending	38	37	36	40
Sewing	15	14	10	20
Food preservation	4	8	45	2
Marketing and account-keeping	20	31	39	35
Care of individual family members	15	10	19	22
Any homemaking	47	47	47	47
Farm work	36	43	40	40
Other work	9	27	18	10
Fancy-work	10	4	8	18
Community activities	18	21	24	15
Miscellaneous activities	44	47	44	47
Personal care	47	47	47	47
Eating meals	47	47	47	47
Sleeping and resting	47	47	47	47
Care of health or illnesses	2	0	2	2

*Spring records were taken from March 16 to May 9, 1936; summer records, in July 1936; fall records, in September 1936; winter records, in February 1937.

dren ready for school and transporting family members, largely in connection with school, did not require time in the summer.

There was some indication that fewer women baked or washed dishes in the summer than in the other seasons; fewer women were ill in the summer; more women participated in community activities in the summer and the fall; the upkeep of the house was maintained by more women in the spring and the summer; special house-cleaning was done by more women in the summer and the winter. There seemed to be some tendency for fewer women to spend time caring for other family members in the summer, which might have been owing to fewer illnesses or to the fact that no time was spent in getting children ready for school. In connection with all of the other activities performed by the homemakers, there was little variation in the number of homemakers reporting from season to season.

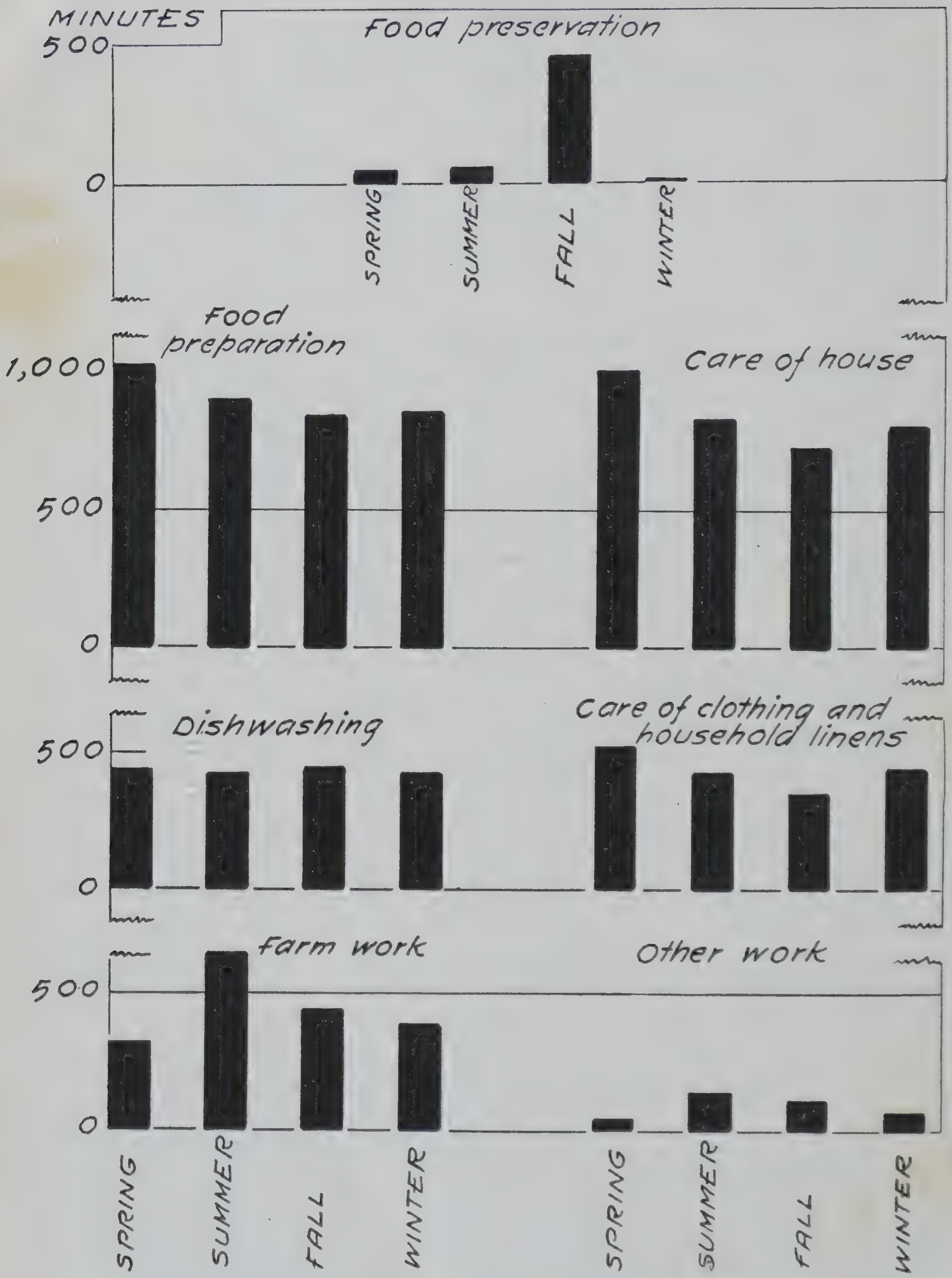

FIGURE 1. SEASONAL VARIATION IN TIME USED BY THE HOMEMAKERS

The time used during a week varied with the season of the year, except for dishwashing. The time used for food preservation was high in the fall; for food preparation, care of the house, and care of clothing and household linens, it was high in the spring; for farm work and other work, it was high in the summer

More time was used on food preparation during the week by the homemaker in the spring than in any other season (figure 1). For baking, the least time was used in the fall and the most time in the spring. For packing lunch pails, the least time was used in the summer because there were fewer pails to be packed.

The time used for dishwashing did not show any significant difference from season to season.

The time used for all care of the house was lowest in the fall and highest in the spring. The most time for daily and weekly house-cleaning was used in the spring. The most time for care of fires was used in the winter and the spring, and the least time in the summer. The most time for special house-cleaning and for upkeep of the house was used in the summer.

The time used for washing clothes seemed to be higher in the summer and the spring than in the fall and the winter, although the differences may not be significant. The time used for ironing was lowest in the winter. More time was used for mending and sewing in the winter and the spring.

The time used for food preservation was highest in the fall. The time used for care of individual family members varied with the composition of the household, not with the season of the year.

The time used for all homemaking activities was lowest in the summer and the winter. The time used for farm work and other work was highest in the summer. The time used for all work was lowest in the winter, but was about the same during the other seasons of the year.

The time spent on fancy-work was much higher in the winter than in any other season, and was lowest in the summer. The time spent on community activities was highest in the fall and lowest in the summer.

The time spent on personal care was highest in the summer. In the fall, less time was used for eating meals and for sleeping and resting, perhaps because there was so much more work to be done. There was more illness reported during the winter than in any other season.

The average time used by all of the homemakers, and by the homemakers doing the tasks, did not always show the same variation with the season; that is, for the few homemakers doing a task, the task might have been relatively important in one season even though the average time used by all homemakers on it did not seem to vary. Less time was spent on mending and sewing in the fall than in any other season, by the homemakers who did this work.

The women who did any food preservation spent the most time on this task in the spring and the fall. Marketing and account-keeping did not show any seasonal variation in time spent per homemaker reporting. Care of individual family members per homemaker reporting was highest in the summer; probably because the older children did not require any help during the summer, and the younger children, who required more help, were the only ones reported upon.

For those reporting, the most time was spent on farm work in the summer but on other work in the winter. More time was spent on community activities during the winter than at other seasons.

The women who were ill during the spring were ill for a longer period than were those who were ill during any other season of the year.

YOUNG CHILDREN IN THE HOUSEHOLD

In the households where there were no children of school age, the homemakers used about the same amount of time for packing lunch pails during all four seasons. The women with young children used much less time for this task in the summer than in the other seasons.

In the households where there were no children, the homemakers used less time for care of fires in the summer and the fall than in the winter and the spring; in the households where there were children, the homemakers used about the same amount of time in the fall as in the winter and the spring.

The homemakers without young children did more sewing and fancywork than did the homemakers with children.

RECORDS TAKEN IN MARCH, APRIL, AND MAY

For a few activities, the month when the spring record was taken was associated with differences in the time used by the homemaker and in the number of homemakers reporting various activities. The percentage of homemakers doing special house-cleaning in March was 8, as compared with 23 per cent in May. The time used for special house-cleaning also increased as the season advanced. Both the percentage of homemakers doing farm work and other work, and the time used for these activities, increased in April and again in May. A large part of the increase in other work may have been due to the fact that gardening was included in this activity. There was a slight tendency for less time to be used for daily care of the house and for weekly house-cleaning during the months when more time was used for special house-cleaning. The time used for care of fires declined slightly in May as compared with March and April.

HELP RECEIVED

A larger number of homemakers received help on homemaking in the winter and the spring than in the summer and the fall (table 54). The largest average amount of help was received by the homemakers in the summer; fewer homemakers received help in the summer, but these homemakers received more help than did the homemakers receiving help in the other seasons. The smallest average amount of help was received by the homemakers in the winter, although nearly all of the homemakers had some help during that season.

The number of homemakers receiving help with preparing breakfast, baking, and packing lunch pails was highest in the spring, while for preparing dinner the number was higher in the summer and in the fall than in the spring. The largest number of homemakers received help with daily care of the house in the summer; with weekly house-cleaning, in the spring; and with care of fires, in the spring and the winter. There was little difference in the number of homemakers receiving help on dishwashing, in the four seasons. The largest number of homemakers had help with washing in the spring and with ironing in the summer. The

TABLE 54. SEASON OF THE YEAR AS RELATED TO NUMBER OF HOMEMAKERS RECEIVING HELP DURING THE WEEK ON VARIOUS HOMEMAKING ACTIVITIES
(47 farm households in Genesee County, New York, 1936–37)

Activity	Number of homemakers receiving help			
	Spring	Summer	Fall	Winter
Food preparation:				
Preparing breakfast	13	9	6	5
Preparing dinner	13	21	22	15
Preparing supper	16	16	18	16
Baking	12	10	7	7
Packing lunch pails	7	2	5	5
Care of house:				
Daily care of house	12	17	10	9
Weekly house-cleaning	17	13	13	9
Bedmaking	16	19	21	18
Care of fires	32	8	14	30
Other care of house	4	0	0	2
Dishwashing:				
Breakfast dishes	19	21	19	16
Dinner dishes	21	25	27	19
Supper dishes	26	26	27	26
Care of clothing and household linens:				
Washing	13	10	10	7
Ironing	11	14	10	6
Mending	6	7	7	3
Sewing	2	4	2	0
Food preservation	1	3	14	0
Care of individual family members	2	1	0	3
Marketing and account-keeping	0	1	0	0
Some help received	44	37	36	42

largest number of homemakers had help with food preservation in the fall; this was the season of the year when most of the homemakers themselves used time for food preservation.

In the spring, the homemakers received the largest average amount of help with preparing breakfast, preparing supper, baking, care of fires, and washing. In the summer, the homemakers received the largest average amount of help with preparing dinner, daily care of the house, weekly house-cleaning, washing breakfast dishes, washing dinner dishes, and ironing. The largest amount of help with bedmaking, washing supper dishes, and food preservation, was reported in the fall.

COOPERATION OF HOUSEHOLD MEMBERS ON CERTAIN ACTIVITIES

In order to study the cooperation among members of the household of various ages and of different sex, a check list was made of tasks which were frequently done in the home. Each homemaker was asked during the interview to tell which of these tasks members of the household usually either helped with or took the entire responsibility for.[18] There were 60 of these tasks, not all of which were done in every home. Some of them were daily routine tasks, and others were seasonal tasks.

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[18] A preliminary examination of the records showed that there was so much disagreement among enumerators and among homemakers as to what constituted responsibility and what was help, that in the analysis no distinction was made between being responsible for and helping with a task. Both were counted equally, and the total was called "tasks on which members of the family cooperated".

As the number of persons in the household increased, the number of tasks on which each person cooperated decreased. In the larger households there were more persons to help on the tasks, and so each person may have had less to do; also, more of the persons in the larger than in the smaller households were too young to help.

In the households of nine or more persons, 30 per cent of the males and 24 per cent of the females did not cooperate on any tasks. Most of the persons not cooperating on any task were children too young to be able to help. In the households of five persons or less, 95 per cent of the males and of the females cooperated on some task.

AGE OF THE PERSON

As the age of the woman or girl increased from infancy to 40 years, the number of tasks on which she cooperated tended to increase steadily; after 40 years of age, the number of tasks on which she cooperated decreased, dropping rapidly after 75 years of age. The women 71 to 75 years of age did as many tasks as did the women 21 to 25 years of age. The younger women spent time on a larger number of the tasks connected with the care of children. The older women had fewer tasks to be done because their children were older and were better able to care for themselves. A smaller percentage of the women over 75 years of age did any of the tasks studied.

Boys who were 10 years of age or older cooperated on about the same number of tasks as did adult males. There seemed to be no significant difference in the number of tasks cooperated on by males between the ages of 10 and 75 years; before males reached the age of 10 and after they were 75, they cooperated on fewer tasks.

TASKS MOST FREQUENTLY AND LEAST FREQUENTLY DONE BY FEMALES OR BY MALES

By females

Of all the women and girls, 81 per cent were responsible for or helped with hanging up their own clothes. Three-fourths or more of them cooperated also on the following tasks: drying dishes, putting away dishes, washing dishes, setting the table, clearing the table, and bedmaking. Of the 60 tasks, 26 were done by more than half of the women and girls. The more frequently reported tasks were those which could be done by all age groups and which were done in the largest number of households.

Between the ages of 8 and 10 years, girls began to cooperate on tasks which younger girls had not helped with nor been responsible for. The younger girls helped with picking up their toys, hanging up their own clothes, picking up the magazines and papers, drying and putting away dishes, setting and clearing the table, playing with younger children, and running errands[19] upstairs or outdoors.

A large percentage of the girls who were more than 10 years of age helped with preparing meals, packing lunch pails, canning, buying their own clothing, gathering vegetables for daily use, routine care of the house, care of the yard, and carrying water, along with the other tasks with which they had been helping previously. In addition to these tasks, many of the girls 15 years of age or older were helping with the laundry work, putting away clothes being the first of the laundry tasks with which they helped. Girls seemed to begin helping with mending, tending fires, and care of the flower garden, at 12 years of age; special house-cleaning, such as cleaning rugs and washing windows, at 13 years; sewing, at about 15 years; care of children, at 17 years; and buying food, papering, and painting, at 18 years.

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[19] Running errands cannot be compared in all cases with the other tasks, because, in general, questions concerning this were not asked unless there were children in the family.

By males

More men and boys were responsible for or helped with bringing in vegetables for winter use than for any other of the 60 tasks listed. More than half of the men and boys cooperated also on the following tasks: care of the vegetable garden; hanging up their own clothes; bringing in fuel for fires; and care of the yard.

About the first of the tasks with which boys were reported as helping was picking up toys; of the boys 4 years old, more than half did this task. Boys a little older were reported as running errands upstairs and outdoors. Boys of 13 years apparently had stopped playing with toys, because very few were reported as helping to pick them up. Hanging up their own clothes was a task done by a high proportion of men and of boys 4 years of age and older. Picking up magazines and papers was done by a smaller number, but still was frequently mentioned in all age groups. Boys about 12 years of age were helping with the buying of their own clothing; a larger proportion of the older boys assumed responsibility for this task.

Several of the boys 5 years of age helped bring in fuel for fires; half of the 9-year-olds usually did this task. Few boys less than 16 years of age helped with tending fires. Although many of the husbands helped with this task, apparently men and boys are not expected to do it so much as are the homemakers, perhaps because the homemaker is in the house and can take care of the fires while she is doing her routine work. One-third of the 10-year-olds were reported as helping empty ashes from fires.

Although many boys ran errands in the house and around the farm at about 3 years of age, few less than 7 years of age were reported as running errands to the neighbors'.

If water was carried, the task was apparently done by boys 10 years of age or older.

Other tasks done by many of the boys were such as should perhaps have been called farm work; but since they were done by several homemakers, they were included in the list. These tasks were: taking care of the yard, which seemed to be done by boys about 6 years of age and older; taking care of the vegetable garden and bringing in vegetables for winter use, tasks which were done by several of the 10-year-olds; and taking care of the chickens, which was done by one-third of the 14-year-olds.

Few of the boys gave any help with food preparation, but of those between the ages of 8 and 14 years many helped with washing dishes and setting the table.

COOPERATION DURING THE WEEK

The record of help received during the week was obtained in two ways: a record of who had helped; and a record of who usually helped. During the week preceding the interview, fewer of the members of the household helped the homemaker than were reported as usually helping. This might have been owing to the failure of the homemaker to mention the short intervals of help; or the help may have been given seasonally; or the record of help received during the week may be more nearly accurate than the record of what the homemaker said was usually done.

Young children, both females and males, most frequently helped with dishwashing. Girls about 10 years of age often helped with bedmaking, and those a few years older helped with other care of the house. Few of the girls less than 15 years of age helped with food preparation, and practically none of them helped with care of clothing. The daughters-in-law, older daughters, and other women helped with all of the homemaking activities.

The young boys frequently helped with dishwashing and care of fires. A large number of the husbands and other men helped with care of fires; several of them helped with dishwashing, especially with the supper dishes. Several of the husbands helped also with preparing breakfast. The number actually doing these tasks during the week reported was far less than the number the homemakers said usually cooperated.

The tasks on which 10 per cent or more of the persons other than the homemaker cooperated, were care of fires, dishwashing, bedmaking, weekly house-cleaning, preparing dinner, and preparing supper; 20 per cent helped with care of fires and washing supper dishes. The smallest number of persons helped with sewing, but this task was done in only a few of the households.

The task on which the largest number of persons not members of the household helped was washing. Ten or more persons outside of the households also had helped with weekly house-cleaning, ironing, washing dinner dishes, bedmaking, and preparing dinner. Most of these helpers were hired to come in and work regularly one day or more during the week. The tasks which they helped with were usually heavier work than the other parts of homemaking.

The time used by the daughters-in-law averaged higher for each individual task than did the time used by the daughters. The daughters may have been away for a part of the day, at school or working. Frequently the daughters-in-law had children of their own to care for, and could have been considered as being the homemaker in a separate household. However, in this study, persons living in the same house and eating meals together were considered to be members of one household.

The time used by husbands averaged higher for all activities than did the time used by other males, except for care of fires and washing.

METHODS OF SAVING TIME MENTIONED BY THE HOMEMAKERS

The homemakers were asked what methods they had for saving time. Of those listing any method, the majority said that planning their work was one of their time-saving methods. There was a good deal of contradiction in the methods listed: some homemakers said they worked better with no routine; some homemakers preferred to combine tasks, while others said they saved time by doing one task at a time; some homemakers saved time by working with the family and obtaining their cooperation, while others said they worked best alone.

The homemakers were asked to express their attitudes toward homemaking tasks. Their answers are reported in the appendix, tables 80 to 84 (pages 94 to 96).

COMBINATION OF TASKS

The homemakers were asked what tasks they usually combined; and also, in giving a record of what they did on the day preceding the interview, they were asked what tasks they had actually combined on that day. The answers to the two questions were compared, so far as was possible.

The washing of breakfast dishes and of milk dishes was the most frequent combination mentioned for the preceding day, and was not reported at all as a usual combination (tables 55 and 56). Baking and preparing dinner was the second most usual combination on the preceding day, and was third in the list of usual combinations. Combining the washing of dishes from two meals ranked high on the actual list but was relatively unimportant on the usual list. The other combinations reported as actually having been done on the day preceding the interview ranked high on the list of usual combinations; apparently, in this case what the homemaker said she usually did, agreed with her actual practice. One combination which probably is more frequent than either list indicates, is combining the guidance of children with some other homemaking activity.

Food preparation, laundry work, and care of the house are the groups of activities which are most frequently combined with some other task.

WORK UNITS

For some time, farm-management research workers have used productive-man-work units[20] as a measure of the size of the farm business and a means for comparing the relative efficiency of farm operators. Since work loads in homes are known to vary greatly, in studying home management a measure of these work loads is one of the essentials. For example, it was thought that work units could be used to compare the results of the different methods of work used in households with similar work loads, and to study in detail households where individual homemaking activities are done in decidedly more or less than the average

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[20] "Productive-man-work units of a farm is the total amount of directly productive work accomplished on that farm in a year. This is figured on the basis of the average amount of man labor required to take care of an acre of the various kinds of crops and the different kinds of livestock . . . Productive-man-work units have nothing to do with yields. . . . The total productive-man-work units of a farm measures the amount of productive work which the farmer set out to do, or the amount which he did, assuming average yields." —S. W. Warren (1932:22–23.)

"Work units are not a measure of how hard men work but of what is accomplished. They are a measure of the amount of productive work done on the farm. Much unproductive work must always be done." —G. F. Warren (1913:353.)

TABLE 55. TASKS WHICH THE HOMEMAKERS COMBINED ON THE DAY PRECEDING THE INTERVIEW

(502* farm homemakers in Genesee County, New York, spring, 1936)

Tasks	Number of homemakers
Washing breakfast dishes and milk dishes	33
Baking and preparing dinner	14
Washing dinner dishes and supper dishes	13
Washing breakfast dishes and supper dishes	11
Preparing dinner and washing	9
Baking and care of house	8
Preparing dinner and care of house	8
Washing breakfast dishes and dinner dishes	8
Washing breakfast dishes and washing	5
Washing and care of house	5
Other tasks	57

*Not all homemakers reported a combination of tasks.

TABLE 56. TASKS WHICH THE HOMEMAKERS USUALLY COMBINED

(502 farm homemakers in Genesee County, New York, spring, 1936)

Tasks	Number of homemakers
Preparing dinner and preparing supper	91
Dishwashing and washing	76
Preparing dinner and baking	70
Baking and ironing	49
Preparing dinner and washing	44
Preparing meals and washing	36
Baking and dishwashing	33
Preparing vegetables and washing	32
Preparing dinner and cleaning	27
Washing and cleaning	24
Washing and making beds	23
Baking and care of house	20
Baking and cleaning	18
Preparing meals and care of children	15
Preparing dinner and making beds	15
Washing and care of children	14
Preparing dinner and mending	14
Preparing dinner and ironing	14
Preparing dinner and picking up around the house	14
Washing and baking	13
Preparing dinner and dusting	12
Preparing meals and dishwashing	12
Washing and care of house	12
Baking and preparing vegetables	11
Baking and mending	11
Preparing meals and care of chickens	10
Washing and picking up around the house	10
Baking and sweeping	10
Other tasks	364
None	76

time. From the present study the data needed for constructing a measure of work loads were available. Preliminary work units were calculated in the hope that they would be useful in future studies of home management, but with the expectation that they would be refined as further information is gained.

When the homemaker was asked how she had used her time and how the helpers had used their time, she was asked also what had been accomplished. For daily tasks the daily accomplishment was recorded, and for weekly tasks the weekly accomplishment. The accomplishment of all workers was considered because all the homemaking activities were being studied, not merely the work done by the homemaker. It is easier to compare households than to compare homemakers, because many activities are common to all households but are not performed entirely by the homemakers in these households. The calculations had to be made on the basis of all the work done in the household, just as the productive-man-work unit used in farm management is calculated on the basis of the work done on the entire farm.

Quality of work done was not measured because of the difficulty of setting up exact, simple standards for quality in homemaking; nor was the equipment used taken into consideration.

The units arrived at are based on Genesee County conditions and methods. They are approximate figures only, and are subject to considerable variation with the practices followed in individual homes.

CONSTRUCTION OF THE WORK UNITS

The first problem was to determine whether the measure of accomplishment for the various tasks recorded on the survey blank was adequate, and, if it was not, whether some other measure could be found. Therefore, for several tasks, correlation coefficients were worked for 25 cases selected at random from the 502 records to determine which of two or three factors was the most closely related to the amount of time used; in this way, decisions were made regarding the measure of accomplishment to be employed. Then the average time used in the households for a specific amount of work accomplished in the various tasks was calculated (appendix, tables 69 to 79, pages 90 to 93). Since the time used per capita for most homemaking activities decreased as the number of persons in the household increased, in constructing the work units the average number of minutes used for a task was calculated for households where the same amount of work was to be done. The average values were plotted, and freehand curves were drawn from them (figures 2 to 13). The values used for the units were then read from these curves. All the very large households were omitted from the calculations, because there were not enough of them to give an accurate average.

Since the records obtained in this study were for only one week, the total work load was calculated for the time used during one week.[21]

For most of the tasks studied, the year's time would probably be one week's time multiplied by 52; however, a few of the tasks that were included varied with the season of the year (pages 56 to 61).

The time used for marketing and account-keeping was not considered accurate, but, as reported, it seemed to be about the same regardless of changes in composition of the household; this factor was therefore omitted from the calculation of work units. The time used for sewing was omitted, because this did not seem to be related to any of the factors capable of numerical measurement. No unit was constructed for upkeep of the house, because not enough households reported on this activity to give a basis for measuring accomplishment. It was decided not to in-

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[21] For bedmaking, packing lunch pails, and dishwashing, the time used in each household on the weekday preceding the interview, and the accomplishment on that day, were employed in calculating the unit; for bedmaking and dishwashing, this figure was multiplied by 7 to give a weekly figure; for packing lunch pails it was multiplied by 5 to give the weekly figure, on the assumption that most of the lunches were for school children.

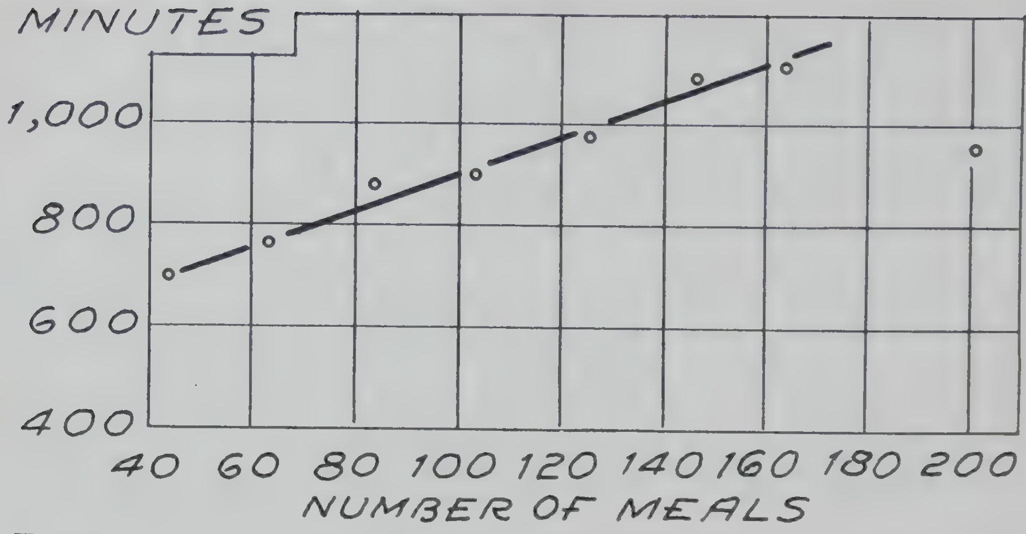

FIGURE 2. NUMBER OF INDIVIDUAL MEALS SERVED AND MINUTES USED DURING THE WEEK FOR MEAL PREPARATION

As the number of meals served increased, the time used for meal preparation increased, but the time used per person per meal decreased, as is shown in table 69 (appendix, page 90)

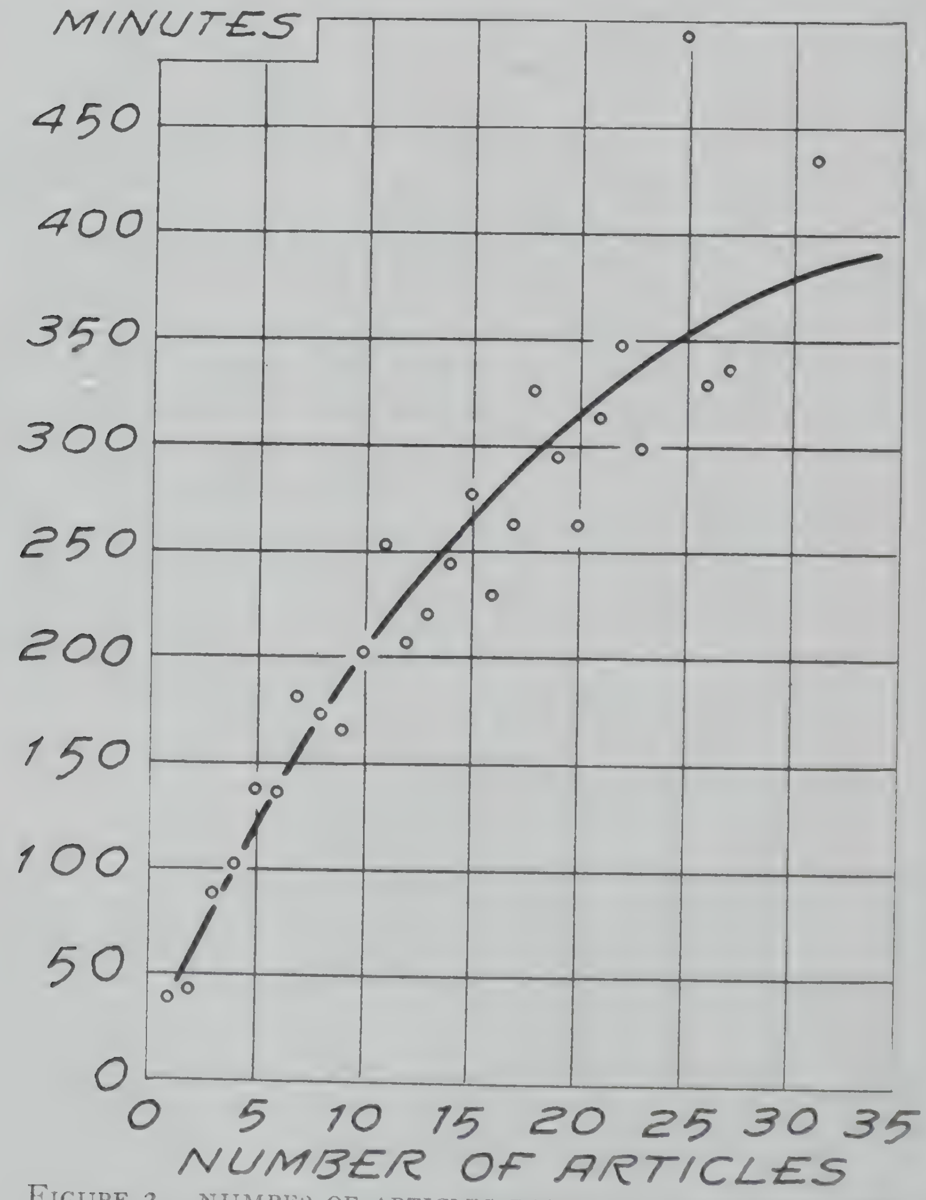

FIGURE 3. NUMBER OF ARTICLES BAKED, AND MINUTES USED DURING THE WEEK FOR BAKING

As the number of articles baked increased from 2 to 20, the time used for baking increased from 44 to 263 minutes clude the highly seasonal tasks, such as food preservation, but to confine the unit to routine tasks done by most of the homemakers.

In the discussion of the various household activities (pages 39 to 53), the effect of certain factors on the time used has been considered. The factors that seemed the most important were used in the construction of the work units and of the index of labor efficiency.

Food preparation

In calculating the unit for meal preparation, the number of persons who ate the meal seemed to be closely associated with the time used. The number of dishes prepared had been recorded, but this seemed not to be very closely associated with the time used for meal preparation; perhaps because there was not enough variability in the number of dishes prepared, or because there was a great deal of variation in the time used to prepare one dish—for example, broiled steak as compared with a stew. As the number of individual meals served weekly increased, the time used for meal preparation increased (figure 2), but the time used per individual meal served decreased (appendix, table 69, page 90). The increase in total time used was consistent up to the group which served 179 or more meals; it was decided to omit this group from the curve.

The amount of baking done increased with the size of the household; but baking was not done in some large households, and in some small households a large amount of it was done. The amount of baking done in the various households, therefore, was compared on the basis of number of articles baked (page 42). As the number of articles baked increased, the time used for baking increased at a decreasing rate (appendix, table 70, page 90; and figure 3). The direction of the curve beyond 27 articles baked was doubtful, and therefore the households where more than 27 articles were baked were excluded from the calculation of the work load.

The time spent for packing lunch pails on the weekday preceding the interview was used in the calculation of the work units. As the number of lunch pails packed increased, the time used daily for packing lunch pails increased (appendix, table 71, page 91; and figure 4). There were so few households where five or more lunches were packed, that these were omitted from the graph.

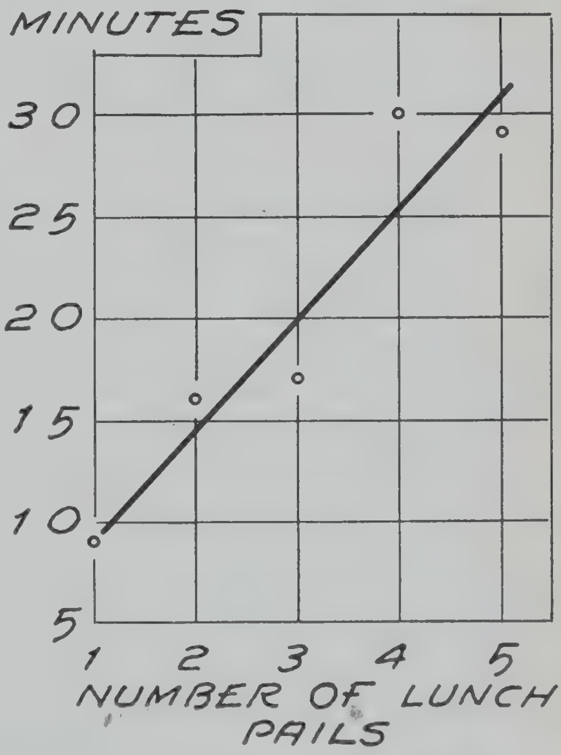

FIGURE 4. NUMBER OF LUNCH PAILS PACKED, AND MINUTES USED DURING THE DAY FOR PACKING LUNCH PAILS

The time used for packing lunch pails increased in direct proportion to the number of pails packed

Dishwashing

The time used on the weekday preceding the interview, and the number of persons served on that day, were used in the calculation of the work units for dishwashing, instead of the weekly figures. As the number of persons eating the meal increased, the time used for dishwashing increased (appendix, table 72, page 91; and figure 5). There were too few cases in which one person or more than eight persons had been served, to warrant including these, and therefore they were omitted in estimating the work load.

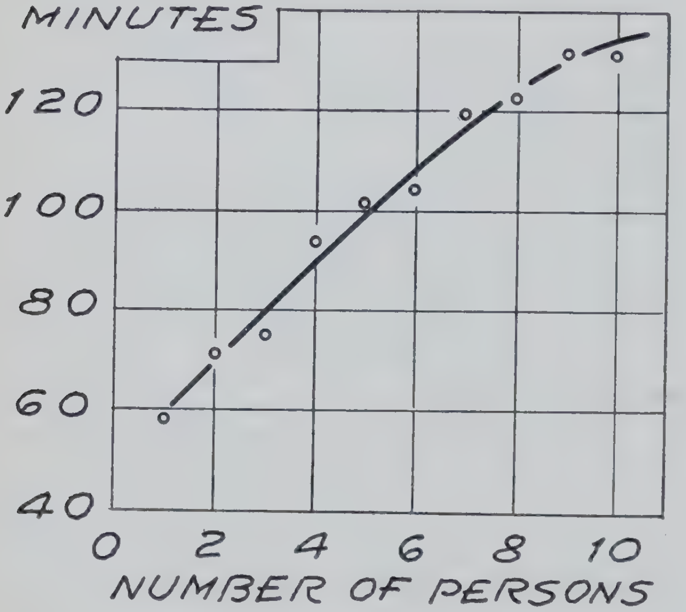

FIGURE 5. NUMBER OF PERSONS FOR WHOM DISHES WERE WASHED, AND MINUTES USED DURING THE DAY FOR DISHWASHING

As the number of persons for whom dishes were washed increased from 2 to 8, the time used during the day for dishwashing increased from 71 to 122 minutes

Care of the house

As the number of rooms in the house increased, the time used for weekly routine care of the house increased (appendix, table 73, page 91; and figure 6). The relationship seemed to be a straight line, but the gross correlation coefficient was only 0.17. The households where nine or more rooms required daily care were omitted from the curve, because there was more variability in this group than in the other groups.

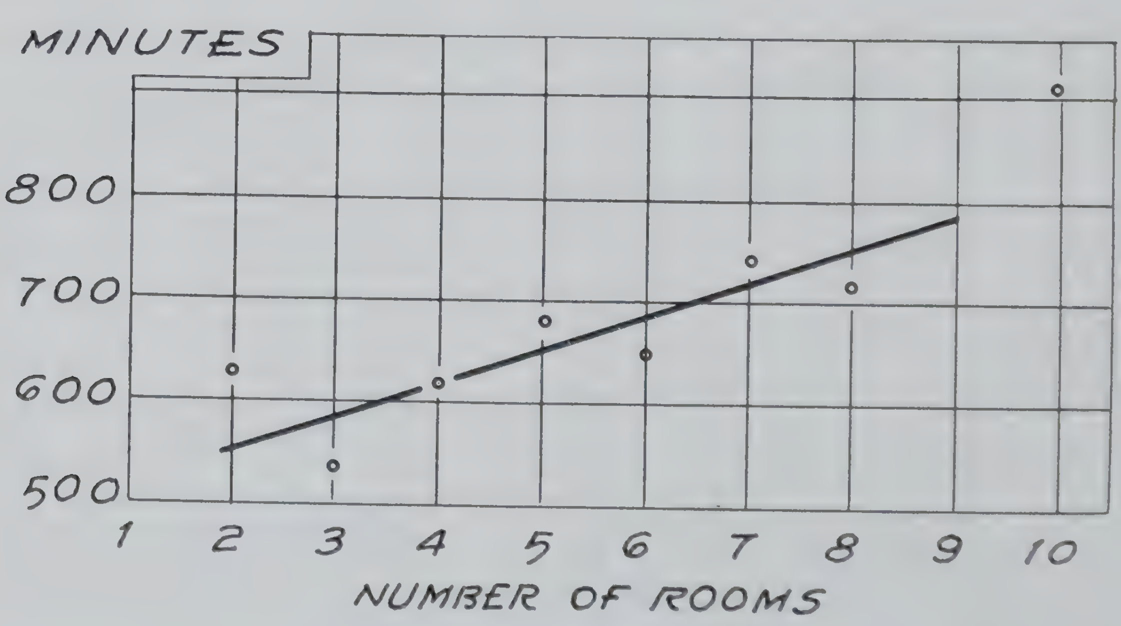

FIGURE 6. NUMBER OF ROOMS REQUIRING DAILY CARE, AND MINUTES USED DURING THE WEEK FOR ROUTINE CARE OF THE HOUSE

As the number of rooms requiring daily care increased, the time used for routine care of the house increased, but the time used per room decreased

The time used for making beds increased as the number of beds made increased (appendix, table 74, page 92; and figure 7). Households in which seven or more beds were made, were not included in the graph.

In constructing the units for care of fires, all houses were classified according to the number of fires regardless of the kind of fuel used or the kind of heating system. As the number of fires increased, the time used for care of fires increased (appendix, table 75, page 92; and figure 8).

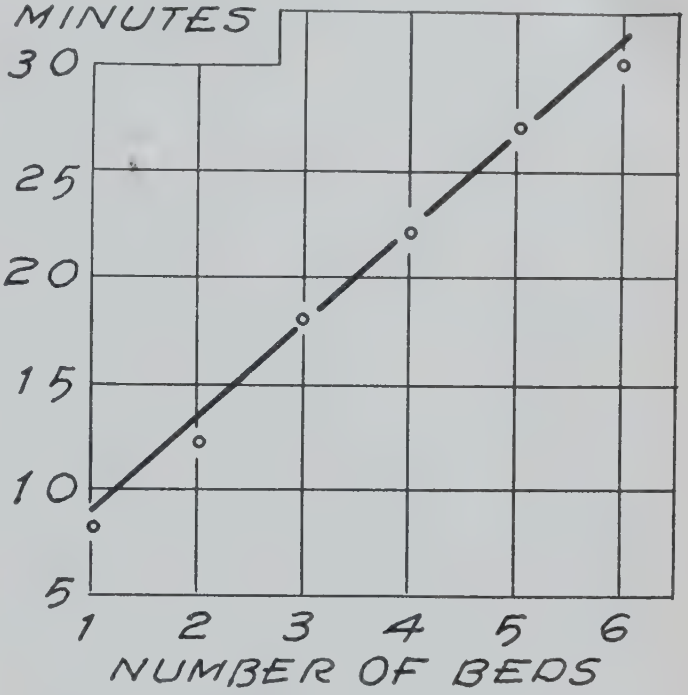

Figure 7. NUMBER OF BEDS MADE, AND MINUTES USED DURING THE DAY FOR BEDMAKING

The time used for making a bed was about the same regardless of the number of beds made

Care of clothing and household linens

In constructing the units for washing clothes, two factors had to be taken into consideration: (1) the number of persons in the household; and (2) the age of the youngest person in the household. It was hoped that the number of articles washed would furnish a good measure of the size of the washing, but as interpreted in this study (page 48) the number of articles washed did not adequately measure the amount of extra washing done for young children. As the number of persons in the household increased, the time used for washing increased (appendix, table 76, page 92; and figure 9). The households of nine or more persons were omitted from the calculation of the work load. It seemed that when the youngest child was under 4 years of age more time was used for washing than would ordinarily be required for a household of the same size composed of adults (figure 10). In estimating the work load, therefore, an increment was added to the time required for a certain number of persons when the youngest person was under 4 years of age.

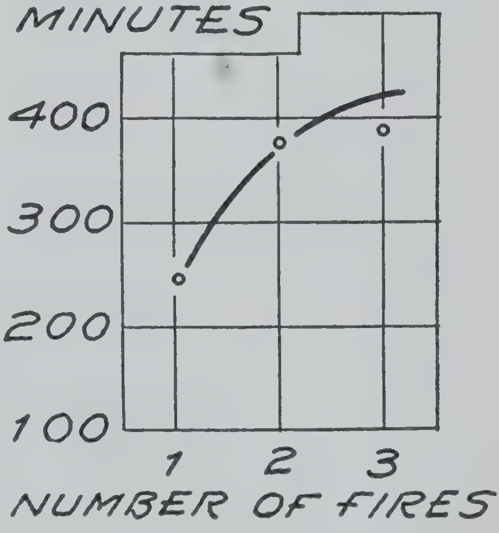

Figure 8. NUMBER OF FIRES KEPT, AND MINUTES USED DURING THE WEEK FOR CARE OF FIRES

Considerably more time was used for two fires than for one, but apparently not much more was required for three than for two

As the number of articles ironed increased, the time used during the week for ironing increased (appendix, table 78, page 93; and figure 11). It was possible to have some time shown as being used for ironing, and

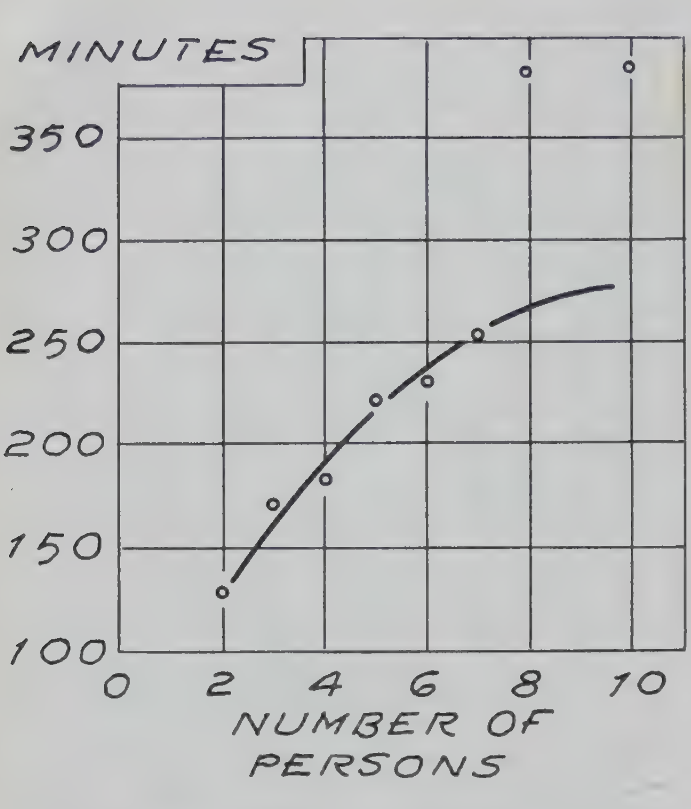

FIGURE 9. NUMBER OF PERSONS IN THE HOUSEHOLD, AND NUMBER OF MINUTES USED DURING THE WEEK FOR WASHING

As the number of persons in the household increased, the time used for washing increased; in households of 8 or more persons it was extremely high, because there were more young children

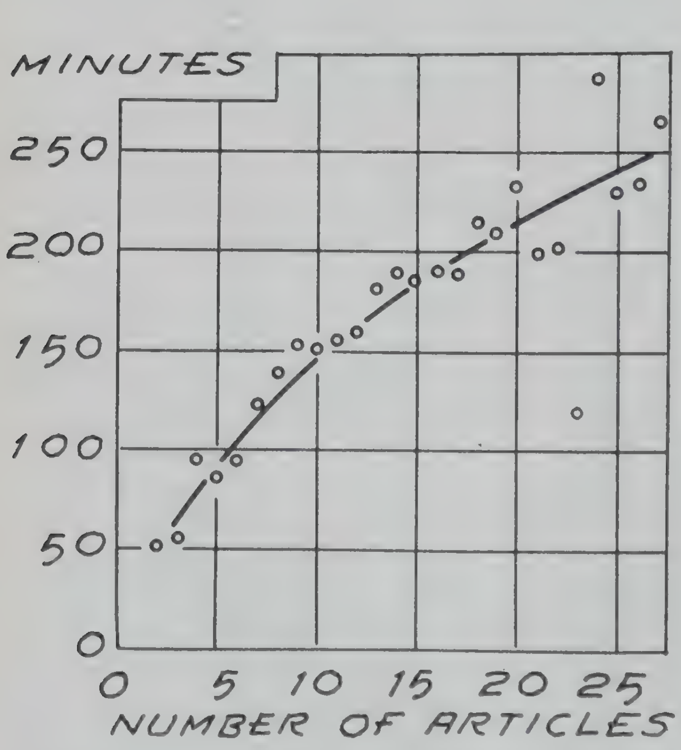

FIGURE 11. NUMBER OF ARTICLES IRONED, AND MINUTES USED DURING THE WEEK FOR IRONING

The time required for ironing increased with the number of articles ironed, but less time was used per article

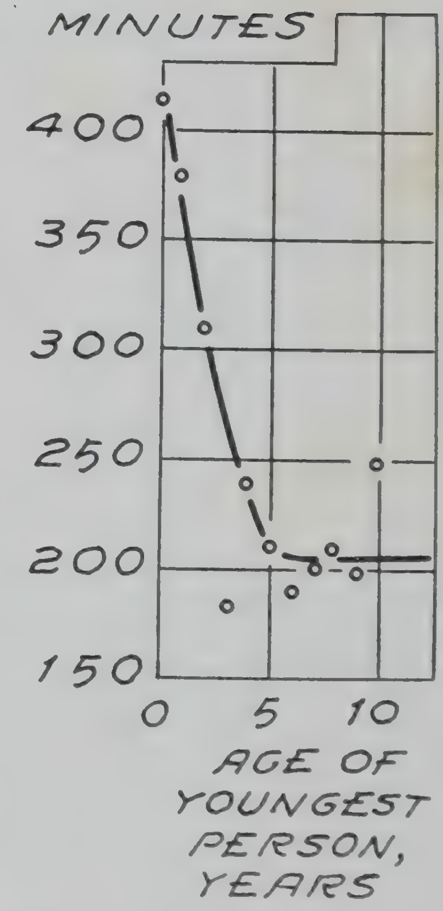

FIGURE 10. AGE OF THE YOUNGEST PERSON IN THE HOUSEHOLD, AND NUMBER OF MINUTES USED DURING THE WEEK FOR WASHING

As the age of the youngest person in the household increased from 1 to 3 years, the time used for washing decreased. After 3 years of age, the time did not seem to be affected by the age of the youngest person still have no articles ironed, because pressing and ironing of small articles were not included in the number of articles ironed (page 48). Households in which more than 22 articles were ironed, were omitted in calculating the work load.

As the number of persons in the household increased, the time used during the week for mending increased (appendix, table 77, page 92; and figure 12). The households of nine or more persons were omitted from the curve. The correlation coefficient was only 0.25, although the relationship seemed to be a straight line.

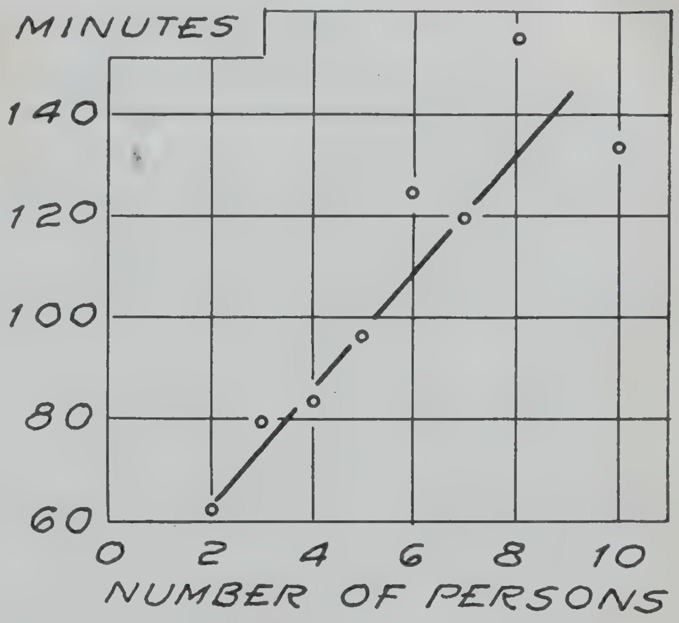

FIGURE 12. NUMBER OF PERSONS IN THE HOUSEHOLD, AND MINUTES USED DURING THE WEEK FOR MENDING

The time used for mending increased in almost direct proportion to the number of persons in the household

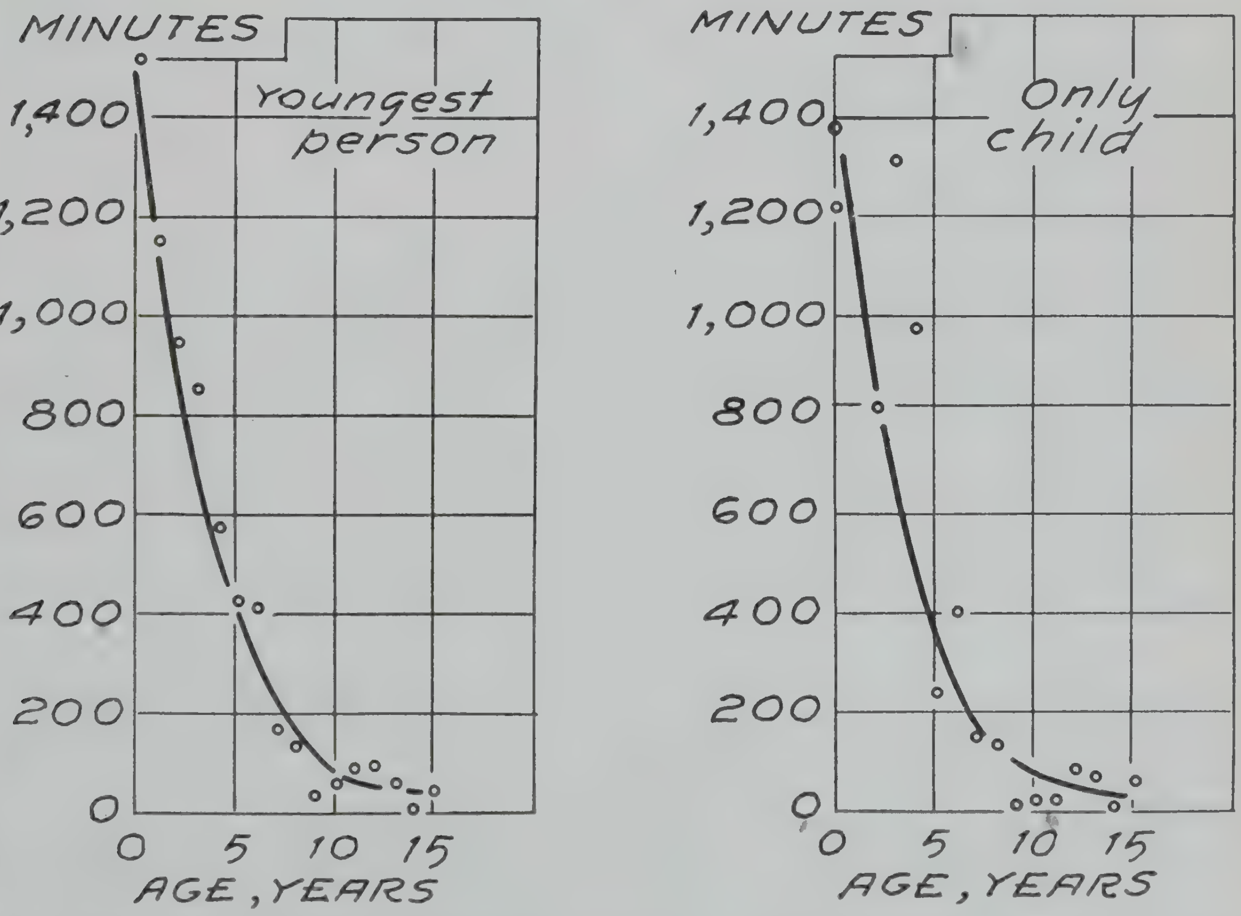

FIGURE 13. AGE OF THE YOUNGEST PERSON IN THE HOUSEHOLD AND OF THE ONLY CHILD, AND MINUTES USED DURING THE WEEK FOR CARE OF INDIVIDUAL FAMILY MEMBERS

The older the child, the less was the time required for care of individual family members. This was true in households with only one child as well as in households with one or more children

Care of individual family members

As the age of the youngest person in the household increased, the time used for care of individual family members decreased (appendix, table 79, page 93; and figure 13). There was a noticeable decrease at about 3 years of age and again at about 9 years. Perhaps at 3 years the children were beginning to carry out most of the routine activities by themselves, and at 9 years they could get themselves ready for school with little or no supervision.

USE OF WORK UNITS IN ESTIMATING AND STUDYING THE WORK LOAD

One purpose of constructing the work units was to provide a means of comparing the work loads of various households on a more or less tangible basis. The estimated work loads of 404 families interviewed in this study were therefore arranged in four groups, from low to high, for the comparison of various factors (table 57).

TABLE 57. ESTIMATED WEEKLY WORK LOAD, AS RELATED TO COMPOSITION OF THE HOUSEHOLD AND VARIOUS FACTORS
(404 farm households in Genesee County, New York, spring, 1936)

Factor	Estimated work load for week			
	Less than 46 hours	46–55 hours	56–65 hours	66 hours or more
Number of households	67	157	106	74
Number of persons in the household	2.3	3.3	4.8	5.9
Number of children less than 16 years of age	0.1	0.4	1.0	2.4
Age of homemaker (years)	54	51	47	41
Age of youngest person in the household (years)	47	27	15	4
Number of women over 14 years old	1.1	1.3	1.7	1.7
Number of girls 6 to 14 years old	....*	0.1	0.4	0.6
Number of organizations whose meetings homemaker attended	1.7	2.2	2.4	2.0
Homemaker's time accounted for on preceding day (minutes)	1,443	1,442	1,447	1,438
Homemaker's time for homemaking in preceding week (minutes)	2,610	2,891	3,008	3,620
Time used by all workers in preceding week (hours)	41	51	60	74
Help received by homemaker in preceding week (minutes)	245	518	930	1,100
Per cent of homemaking done by homemaker	92	86	78	78

*Less than 0.05.

In the households where the work load was high there were more persons and more children than in the households where the work load was low, and the age of the homemaker and the age of the youngest person were lower. The number of women over 14 years of age increased from an average of 1.1 in the households where the work load was estimated as less than 46 hours during the week, to 1.7 in the households where the work load was estimated as 56 hours or more.

More of the households with an estimated work load of 66 hours or more had electricity, than of the households with an estimated work load of less than 46 hours. More households in the group with a relatively high work load used a power washing machine, an electric iron, and an electric vacuum cleaner. The percentage of households having furnaces was about the same in the two groups.

In general, the work load was heavier in the households for which the financial status was slightly lower than average.

The time used during the week by the homemaker increased about 40 per cent as the estimated work load increased from less than 46 hours to 66 hours or more. The average amount of help increased from about 6 hours to about 18 hours. Because of these increases in time used by helpers and homemakers, the time used by all workers was nearly twice as high in the households with an estimated work load of 66 hours or more, as in the households with an estimated work load of less than 46 hours. In the households with the lighter work loads 92 per cent of the homemaking was done by the homemakers, as compared with 78 per cent in the households with the heavier work loads.

The homemakers accounted for approximately the same amount of time during the day preceding the interview, regardless of the estimated work load (table 57). This would indicate that inaccuracies in records had not caused inaccuracies in estimating the work load.

While the average number of organizations whose meetings were attended was about the same in all groups, 37 per cent of the homemakers in the households where the estimated work load was light attended no organization meetings regularly, as compared with 26 per cent of the homemakers in the households where the estimated work load was heavy.

In the households where the estimated work load was light, 6 per cent of the homemakers did not say that they liked any homemaking task, as compared with 17 per cent of the homemakers in the households where the estimated work load was heavy.

An example of the use of work units in estimating and studying work loads of different households is presented in the appendix, pages 96 to 98.

USE OF WORK UNITS IN STUDYING LABOR EFFICIENCY

The work units that have been calculated provide a basis for comparing not only the amount of work to be done, but also the time used for this work in different households with the same work load; in other words, the relative efficiency in performing the work, regardless of the contributing factors. It is recognized that quality of the work, arrangement of equipment, and satisfactions derived, are doubtless important factors that should be considered if they were measurable. In the face of limitations of this nature, however, a few of the results are presented here because they may be of value to other research workers in this field.

Construction of an index of household-labor efficiency

For each household included in the study, the time used for most of the homemaking activities[22] was compared with the time used in the average household, as estimated according to the curves (figures 2 to 13), where the same amount of work was to be accomplished. The time that was used for each task was compared with the estimated time for each task; the totals of the actual time reported and the estimated time also were compared. The estimated time was divided by the actual time, and multiplied by 100. If the tasks were done in less than the average time, the index of household-labor efficiency was over 100; and if the tasks were done in more than the average time, the index was under 100. In households where the task was done in less than the average time, the labor efficiency was high.

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[22] The activities included were: meal preparation, baking, packing lunch pails, routine care of the house, bedmaking, care of fires, dishwashing, washing, ironing, mending, and care of individual family members.

When the estimated time agreed with the time reported by the homemaker, there might have been several reasons for the agreement other than that the household really was like the average, such as: the freehand curve from which the units were read had a good fit at that point; the household used the same amount of time, even though the work done was different in quality from the average; the measure of accomplishment was adequate; the homemaker was accurate in estimating the time used by herself and her helpers.

Use of the index of household-labor efficiency

Except for routine care of the house and washing, the indexes of labor efficiency for individual homemaking activities did not appear to be so satisfactory as the index for all homemaking.

Routine care of the house

The households using an electric vacuum cleaner had a higher index of labor efficiency for routine care of the house than did the other households (table 58). The households without a vacuum cleaner had the lowest index. Apparently, with the same number of rooms requiring daily care, in households using vacuum cleaners the routine care of the house was done in less time.

TABLE 58. KIND OF VACUUM CLEANER, AS RELATED TO INDEX OF LABOR EFFICIENCY FOR ROUTINE CARE OF THE HOUSE

(479 farm households in Genesee County, New York, spring, 1936)

Kind of vacuum cleaner	Number of households	Labor efficiency
No vacuum cleaner	209	117
Hand-power	58	120
Electric	212	125
All households	479	121

The households with a furnace had a higher index of labor efficiency for routine care of the house than did the other households (table 59).

TABLE 59. KIND OF HEATING SYSTEM IN THE HOUSE, AS RELATED TO INDEX OF LABOR EFFICIENCY FOR ROUTINE CARE OF THE HOUSE

(462 farm households in Genesee County, New York, spring, 1936)

Heating system	Number of households	Labor efficiency
Two coal or wood stoves	53	109
One coal or wood stove	170	116
Furnace	239	129
All households	462	122

A furnace may make less dirt in the house than will a stove, and two stoves may make more dirt than will one.

Washing

The households with hand-power washing machines used relatively more time in washing for the same number of persons than did other households (table 60.) The households with electric and gas-engine washing machines had higher indexes of labor efficiency, showing that these two types of machines probably save time, regardless of the quality of the work done.

TABLE 60. KIND OF WASHING MACHINE, AS RELATED TO INDEX OF LABOR EFFICIENCY FOR WASHING

(446 farm households in Genesee County, New York, spring, 1936)

Kind of washing machine	Number of households	Labor efficiency
No washing machine	80	108
Hand-power	56	100
Gas-engine	38	123
Electric	272	120
All households	446	116

All homemaking activities

As the time used by the homemaker for all homemaking activities increased, the labor efficiency of the household decreased. This same relationship was found with the time used by helpers and by all workers. The indication is, therefore, that a larger amount of time used for homemaking was not associated with a larger amount of work to be done in the household.

The households where the homemaker did a large proportion of the homemaking seemed to be the households where homemaking was done most efficiently. As the percentage of homemaking that was done by the homemaker increased, the labor efficiency increased (table 61).

TABLE 61. PERCENTAGE OF HOMEMAKING TIME CONTRIBUTED BY THE HOMEMAKER, AS RELATED TO LABOR EFFICIENCY

(354 farm households in Genesee County, New York, spring, 1936)

Per cent of homemaking time contributed by homemaker	Number of households	Labor efficiency
Less than 50	23	95
50–59	17	96
60–69	30	96
70–79	41	103
80–89	59	104
90–99	119	106
100	65	112
All households	354	104

In general, in the households with the poorer equipment there was a tendency for less time to be spent on homemaking activities than in the households with better equipment, although quality of the work done was not measured.

There was no difference between the index of labor efficiency in tenant and in owner households.

The labor efficiency was not related to the number of organizations to which the homemaker belonged; the homemakers who went to many meetings did not complete their homemaking in less than the average time.

Land class and farm classification did not seem to be related to the index of household-labor efficiency.

The homemakers who liked all phases of homemaking were in households where the labor efficiency was less than the average. These women used more time for all homemaking (page 30). The homemakers who liked baking were in the households where the labor efficiency for baking was 18 points below the average. Apparently, preference for a task prolonged the time used for the task.

Relation between estimated work load and efficiency

As the estimated work load in the household increased, the indexes of labor efficiency for washing and ironing increased; that is, the work was done in less time. The index of labor efficiency for dishwashing decreased from 141 in the households where the work load was light, to 119 in the households where the work load was heavy. Probably dishwashing was done more by helpers, and the index was highest for work done entirely by the homemakers. The indexes of labor efficiency for meal preparation, routine care of the house, baking, and all homemaking, did not seem to be related to the estimated work load. The index was designed to eliminate the variation in time due to the amount of work to be accomplished, and apparently, in general, it was successful.

Where the estimated work load was low but the labor efficiency was high, there were the same number of children as in the households with similar work loads but a lower index (table 62). The same was true of the households with a higher estimated work load. In the households with a higher labor efficiency, the homemaker did more of the homemaking and had had more formal schooling than those in the other households.

Comparison of households with high and those with low labor efficiency

An intensive study was made of the 51 households with the lowest labor efficiency and the 53 households with the highest labor efficiency.[23]

Relatively more of the households with the lowest labor efficiency than of those with the highest, had certain major labor-saving equipment and conveniences: 12 per cent more of the households with the lowest labor efficiency had running water; 20 per cent more had electricity; 10 per cent more had electric washing machines; 14 per cent more had electric irons; 14 per cent more had vacuum cleaners; 3 per cent more had furnaces; 9 per cent more had some hardwood floors in the house. The percentage using wood for cooking was about the same in the two

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[23] An attempt was made to use the 50 households having the highest index of labor efficiency and the 50 households having the lowest index; but the above distribution, 51 and 53 households, respectively, was the best that could be obtained.

TABLE 62. RELATION BETWEEN INDEX OF HOUSEHOLD-LABOR EFFICIENCY AND WORK LOAD, AND VARIOUS FACTORS

(365 farm households in Genesee County, New York, spring, 1936)

Factor	Index of labor efficiency*			
	Low		High	
	Estimated work load during the week†			
	Low	High	Low	High
Number of households	95	88	92	90
Number of persons in the household	2.9	5.2	2.9	5.1
Number of children less than 16 years of age	0.2	1.3	0.2	1.6
Number of women over 14 years of age	1.3	1.7	1.2	1.5
Age of homemaker (years)	53	46	52	43
Age of youngest person in the household (years)	35	12	36	10
Number of organizations whose meetings homemaker usually attends	1.6	2.3	2.5	2.0
Per cent of homemaking done by homemaker	85	75	90	84
Per cent of homes electrified	64	69	62	72
Per cent of homemakers with schooling beyond grade school	60	49	57	59
Per cent of homemakers with schooling beyond high school	8	13	17	14

*Low labor efficiency, less than 104; high labor efficiency, 104 or more.
†Low work load, less than 55 hours; high work load, 55 or more hours.

groups. Again this suggests that the quality of the work is an important factor which was not considered.

The composition of the households in the two groups was similar as to the number of persons in the household, but there were pre-school children in more of the households with the highest labor efficiency. More of the households with the highest labor efficiency had no other woman in the household except the homemaker, and the homemakers in these households tended to be younger than the homemakers in the households with the lowest labor efficiency.

The estimated work load was about the same in the two groups, but the homemaker, helpers, and all workers used much more time during the week in the households where the labor efficiency was lowest (table 63). In the households with the highest labor efficiency, a larger percentage of the homemakers had had formal schooling beyond high school, did all of the homemaking, were born on a farm, and attended the meetings of three or more organizations.

There were a few more families of owners in the group with the lowest labor efficiency, but the farm classification of the two groups was the same. The number of houses with less than five rooms requiring daily care was higher in the group with the highest labor efficiency.

In more of the households with the lowest labor efficiency, some household member other than the homemaker had been ill during the week.

Of the homemakers in the households with the lowest labor efficiency 14 per cent said that planning was one of the time-saving methods which they used, as compared with 34 per cent of the homemakers in the households with the highest labor efficiency. Also, more of the homemakers in the households with the highest labor efficiency said they

TABLE 63. RELATION BETWEEN LABOR EFFICIENCY, WORK LOAD, AND OTHER FACTORS
(104 farm households in Genesee County, New York, spring, 1936)

Factor	51 households with lowest labor efficiency	53 households with highest labor efficiency
	Hours during the week	
Work load:		
Estimated work load	55	57
Actual time used by homemaker	59	40
Actual time used by helpers	15	1
Actual time used by all workers	74	41
	Per cent of households	
Homemaker–		
Had schooling beyond high school	6	18
Did all of the homemaking	14	27
Attended three or more organization meetings	24	43
Was born on farm	46	68
Was born in Genesee County	54	46
Was born in foreign country	6	13
Owners	82	75
Farms classified as very good or excellent	21	22
Houses with less than five rooms requiring daily care	27	45
Illnesses in preceding week:		
Homemaker	6	9
Other persons	14	6
Homemaker liked all parts of homemaking	29	13

planned their time for the week ahead, and sometimes planned their meals on paper.

In the households with the highest labor efficiency, the homemakers did more of the food-purchasing, usually made more of their bread and rolls, and bought more of their cookies.

More of the homemakers in the households with high labor efficiency had earned some outside income during the preceding year.

The homemaker's preferences in homemaking did not seem to be closely related to the labor efficiency of the household, except that somewhat more of the homemakers in the households with the lowest labor efficiency liked all parts of homemaking (table 63). It may be that these homemakers, since they liked everything, either did work of a better quality or else dallied more with their homemaking.

SUMMARY

More than 500 farm households in Genesee County, New York, were studied during the spring of 1936 to determine the activities of the homemakers, the time used for these activities, the causes of variation in the time used, and the work load in different households. In addition, records were obtained from 47 of these households during the summer, fall, and winter to study the effect of season of the year on the various activities. All records were obtained by personal interviews with the homemakers. The area to be studied was chosen to include both good and poor farming sections, and all homes in the area were visited; but the records obtained were from a group of families that were somewhat above the average financially.

The households were about equally divided between small ones, of two, three, or four persons, and large ones, of five to thirteen persons. The average size of household was about four persons. In only half of the households were there children less than 15 years of age, probably because the families of many younger men were eliminated when records were not taken from families where the head of the household was a hired man. The proportion of homemakers who had children less than 1 year of age was higher than in many previous studies of use of time, probably because these women would not have had the time to keep an account of their use of time but were willing to report to an enumerator.

Since the households were from a somewhat better group financially than the average, it was not surprising to find that many of the households were well supplied with time- and labor-saving equipment. The equipment in the house was more closely associated with capital or with farm classification than with any of the other factors studied.

The homemakers used an average of 52 hours during the week for homemaking, which was 83 per cent of the 63 hours used by all workers; they used about 8¾ hours during the day for sleeping and resting, and about the same amount of time for working, leaving about 6½ hours for all other activities such as leisure, personal care, and eating meals.

Care of the house and food preparation were the two most time-consuming homemaking activities. They accounted for two-thirds of the time spent by the homemakers on homemaking.

Except in the relatively few households where the homemaker received more than 2 hours a day of help, the homemakers receiving help worked about as long as did the other homemakers. Usually there was more homemaking to be done in the households where help was received than one person could do alone, and the homemaker had help in order to finish the tasks, not to give herself more leisure. In general, the proportion of the work which was done by helpers was larger in the larger households, except for the care of individual family members, which was not often delegated to helpers.

In general, the earlier the mother started teaching a child, the earlier the child learned to do the routine activity for himself. The learning period, however, was usually shorter if the child was older when the teaching was started, indicating that some physical maturation was necessary in order that the child could learn. Since the learning period was highly variable, it seemed that the guidance of the mother, as well as the maturation of the child, was important in the child's learning.

The homemakers did more farm and other work in the summer and the fall than in the winter and the spring, but their total workday did not vary much with the seasons; in other words, they spent less time on homemaking activities in order to do the other work. The homemaking tasks which varied most with the season of the year were: food preservation, care of fires, sewing, care of school children, special house-cleaning, and upkeep of the house.

An attempt was made to measure the work loads in the households by constructing work units. The average time for a given task was compared with the time actually used in each household for that task, to study the labor efficiency in the household. This made possible some comparison of methods and devices used in different households where there was a similar amount of work to be done. It also made possible some comparison of methods in households in which there was a large work load, with those in households with a small work load.

The homemakers who liked certain activities tended to spend more time than the average on these activities, and the homemakers who disliked certain activities tended to spend less time than the average on these.

The financial status of the family did not seem to be associated with the time used for homemaking activities.

In the households where there were children, the homemaker used more time for homemaking and less for sleeping and leisure than in the other households. The care of a child less than 1 year of age seemed to require about 1000 hours a year over and above the homemaking time required for an adult, in addition to the extra time used for washing.

The homemakers who were very active in community affairs, or who did much farm work, or who had a gainful occupation other than homemaking, tended to use less time for homemaking than did the other homemakers.

Sufficient information of a detailed nature was gained through this study to provide a substantial basis for further studies of factors important in home management. In the present study, the data have been of service in providing a measure of the work load which can be used in studying other households and which should prove useful in studying methods and practices used in accomplishing similar amounts of home work in varying periods of time. In studying and in teaching home management, some such concrete basis for choice-making in regard to quality and quantity of work done should be of value.

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APPENDIX

TABLE 64. Farm Classification and Percentage of Farmhouses with Various Types of Equipment

(467 farmhouses in Genesee County, New York, spring, 1936)

Equipment	Per cent of houses in farm classification*				
	Poor	Fair	Good	Very good	Excellent
Running water	6	21	30	44	56
Sink with drain	50	84	90	86	94
Bathroom	6	14	23	38	50
Cesspool or septic tank	11	27	37	51	72
Electricity	44	59	73	78	89
Vacuum cleaner	22	45	63	68	83
Power washing machine	28	58	74	73	89
Electric iron or ironer	33	54	68	73	89
Electric radio	22	57	69	78	89
Electric or ice refrigeration	22	28	44	53	72
Furnace	0	40	55	74	72
Telephone	33	44	63	73	78
Some hardwood floors	39	49	54	64	72
Electricity and telephone	17	28	48	59	67
Running water and electricity	6	16	27	37	50
Running water and furnace	0	16	23	41	50
Electricity and furnace	0	32	42	60	67
Electricity, running water, and furnace	0	14	22	36	44
Of those having electricity:					
Electric iron or ironer	75	91	94	94	100
Electric washing machine	50	83	87	86	100
Electric vacuum cleaner	38	57	67	75	88
Electric stove	0	15	20	10	19
Electric refrigerator	0	11	20	30	44

*Number of houses in each farm classification; 18 poor, 139 fair, 211 good, 81 very good, 18 excellent.

CLASSIFICATION OF ACTIVITIES OF THE HOMEMAKERS

Homemaking Activities

- Food preparation:
  - Preparing breakfast
  - Preparing dinner
  - Preparing supper
  - Packing school lunches or dinner pails
  - Baking:
    - Cakes
    - Pies
    - Cookies
    - Bread
    - Rolls
    - Doughnuts
  - Other food-preparation activities:
    - Making butter and packing butter (not for sale or less than 10 pounds)
    - Making cheese (not for sale)
    - Waiting on table
    - Preparing baby's food (formula, sterilizing bottles and nipples, etc.)
    - Preparing special meals or extra meals for any members of household
    - Gathering vegetables for a meal

- Food preservation:
  - Butchering
  - Canning, curing, packing, and storing meat
  - Making and canning mincemeat
  - Making sauerkraut
  - Grating horse-radish
  - Making jellies and jams
  - Canning fruits and vegetables

- Dishwashing:
  - Clearing table
  - Washing breakfast dishes
  - Washing dinner dishes
  - Washing supper dishes
  - Washing lunch dishes
  - Washing baking dishes

- Care of house:
  - Daily care of house:
    - Daily dusting
    - Daily sweeping
    - Daily straightening-up of house and keeping it in order
    - Daily care and filling of lamps
    - Carrying water
    - Taking care of house plants
    - Daily mopping of floors
    - Picking up children's clothes
  - Weekly house-cleaning:
    - Weekly dusting
    - Weekly sweeping
    - Weekly straightening-up of house and keeping it in order
    - Weekly mopping
    - Weekly care and filling of lamps
    - Weekly waxing of floors
  - Care of fires:
    - Building fires
    - Tending fires
    - Emptying ashes
    - Chopping and carrying in wood

- Bedmaking
- Special house-cleaning:
    - Cleaning cupboards, closets, drawers, kitchen, pantry, attic, basement, woodshed, etc.
    - Spring cleaning or house-cleaning
    - Preparing for painters or paper-hangers
    - Preparing shelves for canned goods
    - Doing up curtains or taking care of curtains (not washing or ironing)
    - Washing woodwork, windows
    - Blacking stove, if not weekly
    - Waxing floors, if not weekly
    - Airing rugs, mattresses, blankets, etc.
    - Settling house (after moving)
    - Arranging rooms for a new use
- Upkeep of house:
    - Papering
    - Patching paper
    - Tearing off paper
    - Painting woodwork, walls, floors, etc.
    - Waiting on paper-hanger
    - Plastering
    - Painting and fixing screens
    - Caning chairs
    - Refinishing furniture
    - Upholstering chairs
- Other activities in care of house:
    - Working in fruit cellar
    - Cleaning up or straining rain water

Care of clothing and household linens:

- Washing:
    - Soaking clothes
    - Washing clothes and household linens
    - Cleaning up after washing
    - Putting up clothes lines and clothes poles
    - Hanging out wet clothes
    - Taking down and folding clothes
    - Supervising washing
- Ironing:
    - Sprinkling and folding clothes
    - Doing regular ironing
    - Putting clothes away after ironing
    - Doing personal ironing
    - Cleaning and pressing clothes
- Mending
- Sewing:
    - Making garments
    - Remodeling garments
    - Making sheets and pillowcases
    - Making curtains
    - Making other articles for the household

Care of individual family members:

- Taking care of children:
    - Dressing or undressing children
    - Feeding children
    - Bathing children
    - Washing children's hair
    - Combing children's hair
    - Getting children ready and off to school or to church
    - Supervising children's dressing for school
    - Taking children to school or transporting children
    - Helping with lessons
    - Taking children outdoors
    - Putting children to bed or giving them naps
    - Training children for toilet
- Taking care of invalids:
    - Waiting on patients (household members)

Marketing and account-keeping:

- Marketing
- Going to town
- Doing errands away from home
- Putting away purchases
- Keeping household accounts
- Buying from salesman or deliveryman at house

Non-Homemaking Activities

Farm work and business:

- Tending, feeding, and watering chickens, cows, horses, lambs, pigs, baby chicks, calves, hens, ducks, sheep, rabbits, turkeys, goats
- Gathering, cleaning, washing, grading, packing eggs
- Care of incubators
- Cleaning brooder, milkhouse, henhouse, stables, barns, etc.
- Milking
- Washing separator, milk dishes, cooler, strainer, milk utensils, milking machine
- Telephoning for farm business
- Preparing cream and milk for creamery
- Helping with chores or doing them
- Supervising farm
- Working in field, orchard, barn, outdoors, etc.
- Sorting seeds to be planted
- Raking hay
- Driving horses
- Making cheese for sale
- Making butter (over 10 pounds or for sale)
- Making maple sirup
- Delivering products to town or customers (milk, butter, eggs, etc.)
- Marketing farm products (plants, cream, butter, eggs, milk, buttermilk, cottage cheese, chickens, feed, calves, etc.)
- Care of milk and cream (skimming, etc.)
- Keeping cost accounts or account books
- Waiting on customers
- Doing farm errands and shopping for farm
- Talking to agents (egg, butter, cream buyers)
- Helping husband with records and letters

Other work:

- Gainful occupations:
    - Teaching school
    - Acting as town or village or school official
    - Taking care of schoolhouse
    - Acting as newspaper correspondent
    - Agencies
    - Baking and cooking for market
    - Giving music lessons (voice, piano or other instrument)
    - Taking care of animals raised for sale
    - Picking beans at home
    - Doing housework
    - Nursing
    - Working in factory, store, or office
- Neighborly activities:
    - Visiting sick
    - Nursing neighbor
    - Helping neighbor with housework
    - Papering at neighbor's
- Care of pets:
    - Feeding dog
    - Feeding cat
    - Feeding canary
    - Taking care of fish
- Helping members of family not members of household:
    - Helping sister paper
    - Taking care of father's house
    - Helping daughter move
    - Taking care of sick relative
    - Papering at daughter's
    - Working for sister-in-law because she was ill
    - Helping daughter or brother
    - Taking care of grandchild when not member of household
    - Visiting sick aunt
    - Transporting relatives
- Gardening and taking care of grounds:
    - Gathering flowers
    - Working outside, not farm
    - Care of vegetable garden
    - Care of flower garden
    - Shoveling snow
    - Mowing, raking, and taking care of lawn
- Other occupations:
    - Taking care of car
    - Moving
    - Interruptions, not specified
    - Doing general work and odd jobs, not specified
    - Straightening up house (just moved in)

- Personal activities:
  - Sleeping and resting:
    - Sleeping (at night)
    - Resting
    - Taking a nap
  - Personal care, including dressing:
    - Dressing
    - Undressing
    - Bathing
    - Going to beauty parlor
    - Hairdressing
  - Eating meals
  - Care of health or illnesses:
    - Going to doctor
    - Going to dentist
    - Being sick

- Other activities:
  - Fancy-work:
    - Crocheting
    - Making a quilt
    - Making a rug
    - Embroidering
    - Knitting
    - Tatting
    - Doing needlepoint
  - Community activities:
    - Attending organization meetings, including Church, Ladies' Aid, Transit Friendly Club, Dairymen's League, Home Bureau, Neighborhood Club, Grange, Bird and Garden Club, Auxiliary, Missionary, Sunday School, Eastern Star, 4-H Club, prayer meetings, recreation school, G.L.F., Mothers' Club, Guild
    - Attending committee meetings
    - Preparing for meetings—either food or program—including studying Sunday School lesson, preparing for and helping at church suppers and other entertainments
    - Attending play or choir or minstrel-show rehearsals
    - Going to entertainments of regularly organized groups, such as community play, speaking contest, church supper, school entertainments, Sunday School party, quilting bee
    - Visiting a centralized school or other schools
    - Giving program at meetings, such as 4-H Club and Garden Club
    - Attending funerals

- Miscellaneous activities:
  - Reading
  - Sitting
  - Doing nothing
  - Studying
  - Playing victrola, piano
  - Saying or reading prayers
  - Writing letters
  - Writing in diary
  - Reading to children
  - Playing with children
  - Talking with children or other members of family
  - Waiting for persons to eat
  - Having callers
  - Entertaining
  - Visiting
  - Visiting at table
  - Working on puzzles
  - Playing games
  - Going after mail
  - Sorting out recipes
  - Telephoning
  - Listening to radio
  - Going away from home for meals
  - Going to movies, parties, plays, picnics, etc.
  - Walking
  - Watching others work
  - Transporting people
  - Riding or driving
  - Calling or visiting
  - Away from home
  - Playing cards or going to card parties
  - Attending cooking school
  - Attending an auction

TABLE 65. VARIABILITY IN TIME USED DURING THE WEEK (PER HOMEMAKER)
(497 farm homemakers in Genesee County, New York, spring, 1936)

Activity	Minutes used during the week				Quartile coefficient of variability
	Average	First quartile	Median	Third quartile	
Any homemaking activity	3,115	2,500	3,100	3,700	19
Food preparation	982	810	960	1,160	18
Preparing breakfast	162	110	140	210	36
Preparing dinner	345	240	360	420	25
Preparing supper	231	150	210	300	36
Baking	197	90	180	270	50
Packing lunch pails	31	0	0	50	∝
Dishwashing	434	320	420	540	26
Breakfast dishes	133	80	110	210	59
Dinner dishes	167	110	150	210	33
Supper dishes	135	90	140	210	43
Care of house	978	690	910	1,210	29
Daily care of house	372	210	360	460	35
Weekly house-cleaning	187	120	180	240	33
Special house-cleaning	70	0	0	0	0
Care of fires	218	70	180	380	86
Bedmaking	95	70	80	110	25
Upkeep of house	38	0	0	0	0
Care of clothing and household linens:					
Washing	168	120	150	210	30
Ironing	125	60	120	180	50
Mending	81	30	60	120	75
Sewing	43	0	0	0	0
Care of individual family members	221	0	0	210	∝
Marketing and account-keeping	76	0	0	120	∝
Food preservation	12	0	0	0	0
Farm work	410	70	210	560	117
Other work	120	0	0	60	∝
Fancy-work	59	0	0	0	0
Community activities	60	0	0	0	0
Miscellaneous activities	932	400	840	1,290	53
Sleeping and resting	3,666	3,360	3,570	3,950	8
Personal care	251	140	210	330	45
Eating meals	551	420	530	630	20
Care of health or illnesses	17	0	0	0	0

TABLE 66. VARIABILITY IN TIME USED ON THE WEEKDAY PRECEDING THE INTERVIEW (PER HOMEMAKER)

(497 farm homemakers in Genesee County, New York, spring, 1936)

Activity	Minutes used during the day				Quartile coefficient of variability
	Average	First quartile	Median	Third quartile	
Any homemaking activity	493	370	500	610	24
Food preparation	138	100	130	170	27
Preparing breakfast	23	15	20	30	38
Preparing dinner	44	30	45	60	33
Preparing supper	33	20	30	45	42
Baking	28	0	0	50	∝
Packing lunch pails	5	0	0	10	∝
Dishwashing	61	40	60	80	33
Breakfast dishes	18	10	15	30	67
Dinner dishes	22	10	20	30	50
Supper dishes	19	10	20	30	50
Care of house	157	80	130	200	46
Daily care of house	56	30	55	75	41
Weekly house-cleaning	15	0	0	0	0
Special house-cleaning	26	0	0	0	0
Care of fires	32	10	30	60	83
Bedmaking	13	10	10	15	25
Care of clothing and household linens:					
Washing	27	0	0	0	0
Ironing	20	0	0	0	0
Mending	13	0	0	0	0
Sewing	8	0	0	0	0
Care of individual family members	31	0	0	30	∝
Marketing and account-keeping	32	0	0	0	0
Farm work	69	10	30	90	133
Other work	34	0	0	0	0
Fancy-work	10	0	0	0	0
Community activities	22	0	0	0	0
Miscellaneous activities	172	60	150	240	60
Sleeping and resting	530	480	510	570	9
Personal care	39	20	30	50	50
Eating meals	79	60	80	90	19

TABLE 67. NUMBER OF PERSONS IN THE HOUSEHOLD AND NUMBER OF CHILDREN UNDER 15 YEARS OF AGE, AS RELATED TO TIME USED BY THE HOMEMAKER FOR VARIOUS ACTIVITIES

(497 farm households in Genesee County, New York, spring, 1936)

Activity	Households of less than 5 persons*		Households of 5 or more persons†	
	Number of children in the household			
	0	1 or more	0	1 or more
	Minutes used during the week			
All homemaking activities	2,757	3,292	2,746	3,563
Food preparation	898	983	957	1,096
Preparing breakfast	149	167	150	178
Preparing dinner	348	351	353	336
Preparing supper	204	235	213	267
Baking	168	179	200	241
Packing lunch pails	10	28	30	59
Dishwashing	402	437	341	437
Breakfast dishes	129	152	105	135
Dinner dishes	163	168	172	172
Supper dishes	131	142	116	141
Care of house	979	1,018	870	979
Daily care of house	394	362	314	359
Weekly house-cleaning	184	201	148	192
Special house-cleaning	76	109	33	53
Care of fires	213	220	246	219
Bedmaking	83	99	81	112
Care of clothing and household linens:				
Washing	134	164	176	212
Ironing	104	133	122	149
Mending	65	83	88	100
Sewing	38	38	44	53
Care of individual family members	47	287	76	456
Marketing and account-keeping	85	75	88	63
Farm work	439	372	250	365
Other work	123	71	79	146
Fancy-work	85	36	107	26
Community activities	61	57	71	59
Miscellaneous activities	1,055	877	1,232	746
Sleeping and resting	3,776	3,665	3,621	3,532
Personal care	258	270	232	235
Eating meals	554	544	528	556

*217 households with no children; 79 households with children.
†33 households with no children; 168 households with children.

TABLE 68. NUMBER OF PERSONS IN THE HOUSEHOLD AND NUMBER OF CHILDREN UNDER 15 YEARS OF AGE, AS RELATED TO TIME USED BY ALL WORKERS FOR HOMEMAKING ACTIVITIES

(497 farm households in Genesee County, New York, spring, 1936)

Activity	Households of less than 5 persons*		Households of 5 or more persons†	
	Number of children in the household			
	0	1 or more	0	1 or more
	Minutes used during the week			
All food preparation	1,002	1,038	1,259	1,327
Dishwashing	513	542	670	720
All care of house	1,217	1,180	1,296	1,332
Care of individual family members	32	342	76	531
Help received by the homemaker	506	392	1,225	994
All homemaking activities	3,281	3,694	3,973	4,582

*217 households with no children; 79 households with children.
†33 households with no children; 168 households with children.

TABLE 69. NUMBER OF MEALS SERVED DURING THE WEEK, AS RELATED TO TIME USED BY ALL WORKERS FOR MEAL PREPARATION

(489 farm households in Genesee County, New York, spring, 1936)

Number of meals served*	Number of households	Minutes used for meal preparation	Minutes used per person per meal
Less than 53	69	692	16
53–73	108	759	12
74–94	115	870	10
95–115	89	893	9
116–136	49	964	8
137–157	29	1,088	7
158–178	15	1,117	7
179 or more	15	949	5

*Not including lunch pails.

TABLE 70. NUMBER OF ARTICLES BAKED, AS RELATED TO TIME USED DURING THE WEEK BY ALL WORKERS FOR BAKING

(468 farm households in Genesee County, New York, spring, 1936)

Number of articles baked*	Number of households	Minutes used for baking
1–5	79	94
6–10	131	170
11–15	113	238
16–20	68	276
21–25	37	365
26–30	16	371
31 or more	24	393

*One article consists of one cake, one pie, one loaf of bread, one dozen cookies, one dozen rolls, or one dozen friedcakes.

TABLE 71. NUMBER OF LUNCH PAILS PACKED, AS RELATED TO TIME USED DURING THE DAY BY ALL WORKERS FOR PACKING LUNCH PAILS

(215 farm households in Genesee County, New York, spring, 1936)

Number of lunch pails packed	Number of households	Minutes used for packing lunch pails
1	96	9
2	63	16
3	35	17
4	21	30

TABLE 72. NUMBER OF PERSONS EATING EACH MEAL, AS RELATED TO TIME USED DAILY BY ALL WORKERS FOR DISHWASHING

(497 farm households in Genesee County, New York, spring, 1936)

Number of persons eating each meal	Minutes used for dishwashing
1	58
2	71
3	75
4	94
5	101
6	104
7	119
8	122
9	131
10	131

TABLE 73. NUMBER OF ROOMS IN THE HOUSE REQUIRING DAILY CARE, AS RELATED TO TIME USED DURING THE WEEK BY ALL WORKERS FOR ROUTINE CARE OF THE HOUSE

(494 farm households in Genesee County, New York, spring, 1936)

Number of rooms in house	Number of households	Minutes used for routine care of house	
		Per household	Per room cleaned
Less than 3	22	613	329
3	58	531	177
4	82	614	154
5	111	679	136
6	92	646	108
7	67	734	105
8	33	710	89
9 or more	29	904	92
All households	494	665	123

TABLE 74. Number of Beds Made, as Related to Time Used Daily by All Workers for Bedmaking

(486 farm households in Genesee County, New York, spring, 1936)

Number of beds made	Number of households	Minutes used for bedmaking
1	50	8
2	132	12
3	133	18
4	100	22
5	55	27
6	16	30

TABLE 75. Number of Fires Used for Heating House and for Cooking, as Related to Time Used during the Week by All Workers for Care of Fires

(469 farm families in Genesee County, New York, spring, 1936)

Number of fires used*	Number of families	Minutes used for care of fires
1	141	243
2	294	376
3	34	389

*Not including kitchen stove.

TABLE 76. Number of Persons in the Household, as Related to Time Used Weekly by All Workers for Washing

(501 farm households in Genesee County, New York, spring, 1936)

Number of persons in household	Number of households	Number of articles washed	Minutes used weekly for washing
2	75	12	128
3	111	18	170
4	112	21	184
5	86	24	221
6	43	27	230
7	37	29	252
8	20	39	382
9 or more	17	36	383

TABLE 77. Number of Persons in the Household as Related to Time Used Weekly by All Workers for Mending*

(497 farm households in Genesee County, New York, spring, 1936)

Number of persons in household	Number of households	Minutes used weekly for mending
2	74	62
3	109	79
4	111	83
5	86	96
6	43	124
7	37	119
8	20	154
9 or more	17	133

*r =0.25.

TABLE 78. NUMBER OF ARTICLES IRONED WEEKLY, AS RELATED TO TIME USED BY ALL WORKERS FOR IRONING

(433 farm households in Genesee County, New York, spring, 1936)

Number of articles ironed weekly	Number of households	Minutes used weekly for ironing
2	4	50
3	8	59
4	14	94
5	12	85
6	14	94
7	15	121
8	30	137
9	29	151
10	34	150
11	28	153
12	29	156
13	33	180
14	23	188
15	24	187
16	26	188
17	22	188
18	12	213
19	17	208
20	16	231
21	15	198
22	8	200
23	3	120
24	4	285
25	3	230
26	5	234
27	5	262

TABLE 79. AGE OF YOUNGEST PERSON IN THE HOUSEHOLD, AS RELATED TO TIME USED DURING THE WEEK BY ALL WORKERS FOR CARE OF INDIVIDUAL FAMILY MEMBERS

(242 farm households in Genesee County, New York, spring, 1936)

Age of youngest person in household	Number of households with children	Number of households with only 1 child	Minutes used for care of family members	
			In households with children	In households with only 1 child*
Less than 11 months	19	5	1,528	1,216
1 year	5	..	1,154	.....
2 years	27	6	942	812
3 years	17	4	855	1,303
4 years	15	4	572	970
5 years	11	3	423	240
6 years	16	6	415	398
7 years	9	2	161	150
8 years	15	9	133	129
9 years	7	4	37	13
10 years	19	11	55	19
11 years	13	5	86	20
12 years	12	9	98	83
13 years	21	19	69	76
14 years	19	16	5	6
15 years	17	10	44	60

*Includes all care of family, but only 1 child in these households.

TABLE 80. BEST-LIKED ACTIVITIES AS REPORTED BY THE HOMEMAKERS
(502 farm homemakers in Genesee County, New York, spring, 1936)

Activity	Number of homemakers*	Per cent of homemakers
Cooking and meal preparation	138	27
Sewing	82	16
Cleaning and keeping the house in order	75	15
Baking	72	14
Gardening	24	5
Ironing	21	4
Washing	19	4
Home decorating	18	4
Canning	16	3
Caring for children	13	3
Farming or other work	8	2
Dishwashing	5	1
Butter-making	4	1
Mending	4	1
Fancy-work	4	1
Planning	2	..†
Nursing	2	..†
Entertaining	1	..†
Planning meals	1	..†
Shopping	1	..†
Playing piano	1	..†
"Everything"	88	18
None or not reported	68	14

*Several homemakers reported more than one activity.
†Less than 0.5 per cent.

TABLE 81. MOST FATIGUING ACTIVITIES AS REPORTED BY THE HOMEMAKERS
(502 farm homemakers in Genesee County, New York, spring, 1936)

Activity	Number of homemakers*	Per cent of homemakers
Cleaning and keeping the house in order	162	32
Washing	104	21
Ironing	84	17
Cooking and meal preparation	13	3
Baking	13	3
Dishwashing	10	2
Standing	7	1
Sewing	6	1
Caring for children	5	1
Working outside	5	1
Carrying water	4	1
Churning	4	1
Preserving food	4	1
Bedmaking	3	1
Gardening	3	1
Laundering	3	1
Other activities	23	5
"Everything"	31	6
None or not reported	106	21

*Several homemakers reported more than one activity.

TABLE 82. MOST DISAGREEABLE ACTIVITIES AS REPORTED BY THE HOMEMAKERS
(502 farm homemakers in Genesee County, New York, spring, 1936)

Activity	Number of homemakers*	Per cent of homemakers
Cleaning and keeping the house in order	106	21
Dishwashing	33	7
Washing	22	4
Ironing	22	4
Cooking and meal preparation	20	4
Mending or darning	16	3
Sewing	12	2
Special cleaning	12	2
Baking	11	2
Bedmaking	4	1
Care of fires	4	1
Churning	4	1
Preparing vegetables	4	1
Canning	3	1
Care of chickens	3	1
Washing milk dishes	3	1
Butchering	2	..†
Caring for children	2	..†
Carrying water	2	..†
Other activities	10	2
"Everything"	5	1
None or not reported	243	48

*Several homemakers reported more than one activity.
†Less than 0.5 per cent.

TABLE 83. ACTIVITIES THAT PRESENT THE GREATEST PROBLEM AS REPORTED BY THE HOMEMAKERS
(502 farm homemakers in Genesee County, New York, spring, 1936)

Problem	Number of homemakers*	Per cent of homemakers
Planning meals	43	9
Cooking and meal preparation	33	7
Care of children	29	6
Financial problems	29	6
Planning use of time or getting things done	20	4
Cleaning and keeping the house in order	16	3
Baking	14	3
Sewing	13	3
Health of family or of homemaker herself	6	1
Lack of conveniences	6	1
Home decorating	6	1
Mending	6	1
Canning	5	1
Special cleaning	4	1
Caring for invalids	3	1
Farm or outdoor work	3	1
Butter-making	3	1
Buying	3	1
Washing	2	..†
Other activities	20	4
"Everything"	8	2
None or not reported	250	50

*Several homemakers reported more than one activity.
†Less than 0.5 per cent.

TABLE 84. ACTIVITIES FOR WHICH THE HOMEMAKERS WOULD LIKE MORE TIME
(502 farm homemakers in Genesee County, New York, spring, 1936)

Activity	Number of homemakers*	Per cent of homemakers
Sewing	112	22
Cleaning and keeping the house in order	43	9
Gardening and care of lawn	36	7
Fancy-work	31	6
Reading	24	5
Home decorating	22	4
Caring for children	17	3
Cooking	16	3
Baking	13	3
Mending	12	2
Resting and sleeping	9	2
Work outside	6	1
Recreation	6	1
Going away from home	6	1
Preparing meals	4	1
Canning	3	1
Caring for person	3	1
Painting	2	1
Buying	1	..†
Ironing	1	..†
Planning	1	..†
Studying	1	..†
Washing	1	..†
Writing letters	1	..†
"Everything"	11	2
None or not reported	187	37

*Several homemakers reported more than one activity.
†Less than 0.5 per cent.

EXAMPLE OF USE OF WORK UNITS

Family A: 3 adults and child of 2 years; 5 rooms used with furnace heat; 3 beds to make; no lunch pails; 10 articles ironed; 2 cakes and 1 pie baked.

Family B: 5 adults and no children; 7 rooms used with 2 heating stoves; 5 beds to make; 2 lunch pails; 20 articles ironed; 15 loaves of bread and 5 dozen cookies baked.

CALCULATION OF TOTAL WORK LOAD (FROM TABLES ON PAGES 97 AND 98)

Activity	Family A		Family B	
	Number of items	Work units*	Number of items	Work units*
Meal preparation	4	840	5	914
Packing lunch pails	..	.....	2	75
Baking	3	78	20	310
Dishwashing	4	623	5	693
Routine care of house	5	651	7	717
Care of fires	1	245	2	375
Bedmaking	3	126	5	189
Washing	4	192	5	218
Washing for young children	2	60	..	.....
Ironing	10	146	20	216
Mending	4	86	5	97
Care of individual family members	2	820	..	.....
Total minutes for one week (work load)		3,867		3,804
Total hours for one week (work load)		64		63

*Pages 97 and 98.

The work load in these two families is similar, but more time was used in family A for care of individual family members, and less time for all other parts of homemaking, than in family B. If desirable, the estimated work loads for the two families could be compared with the time actually used, to see in which activities they were particularly efficient in the use of time and in which activities they were not efficient.

WORK UNITS IN MINUTES (AS READ FROM FIGURES 2 TO 13)

Number of persons in the household or eating three meals daily	Work units (minutes)			
	Meal preparation	Dish-washing	Washing*	Mending
2	694	483	125	63
3	767	553	160	75
4	840	623	192	86
5	914	693	218	97
6	987	756	237	109
7	1,060	812	252	120
8	1,133	861	265	132

*Also see age of youngest person.

Number of rooms in house	Work units (minutes)
	Routine care of house
2	553
3	587
4	620
5	651
6	683
7	717
8	750

Age of youngest person (years)	Work units (minutes)	
	Care of individual family members	Washing (to be added to unit for washing based on number of persons in the household)
Less than 1	1,390	165
1	1,040	110
2	820	60
3	630	25
4	460	
5	325	
6	230	
7	165	
8	125	
9	90	
10	70	
11	55	
12	45	
13	40	
14	30	
15	25	

Number of articles baked	Work units (minutes)
	Baking
1	30
2	55
4	100
6	137
8	170
10	197
12	225
14	248
16	270
18	290
20	310
22	328
24	343

Number of articles ironed	Work units (minutes)
	Ironing
2	40
4	76
6	105
8	128
10	146
12	163
14	177
16	193
18	205
20	216
22	227
24	236

Number of fires, excluding kitchen stove	Work units (minutes)
	Care of fires
1	245
2	375
3	420

Number of beds	Work units (minutes)
	Bedmaking
1	63
2	91
3	126
4	154
5	189
6	217

Number of lunch pails*	Work units (minutes)
	Packing lunch pails
1	45
2	75
3	100
4	125

*Assuming lunch pails packed five days a week.

Bulletin 735 June 1940

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An Analysis of Dealers' Sales of Milk and Cream in the New York Market, 1933-38

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Charles J. Blanford

In cooperation with the Bureau of Agricultural Economics of the
United States Department of Agriculture

TYPES OF CONTAINERS USED IN THE NEW YORK MARKET

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AN ANALYSIS OF DEALERS' SALES OF MILK AND CREAM IN THE NEW YORK MARKET, 1933-38

CHARLES J. BLANFORD

PURPOSE

The purpose of this study was to analyze fresh-milk and -cream sales in order to determine consumer responses to price changes, business conditions, seasons, and the like, during a period of business depression and recovery.

NATURE AND SOURCES OF THE DATA

Receipts of fresh milk and cream by rail and truck, as reported by the Market News Service of the United States Department of Agriculture, were used to indicate long-time trends in consumption of these products. A special survey was made to obtain more complete data on receipts by motor trucks.[1]

Records of weekly and monthly sales of fresh milk and cream were obtained from the four largest milk distributors in the market, and several of the smaller ones, for the period 1933-38.

Records of sales of fresh milk and cream by all milk distributors in New York City for one day of each quarter in 1937 and 1938 were obtained from the Department of Health of the city of New York.

Data concerning monthly sales in Class I (fluid milk) and Class IIA (fluid cream), during the years 1933-38, by all dealers licensed by the Division of Milk Control of the New York State Department of Agriculture and Markets were made available by that division.

Most of the data analyzed in this study pertain to New York City; however, part of the information, particularly that concerning the retail sales of the larger distributors, pertain to the entire New York metropolitan market.

THE NEW YORK MARKET

The New York metropolitan market is described as follows: "This market lies in two states, New York and New Jersey. As often defined, it also includes a small area in Connecticut. It covers all or a part of seventeen counties, including scores of municipalities, ranging in size from New York City to smaller commuter centers in northern New Jersey, Long Island, and Westchester County".[2]

The population of this metropolitan market is estimated at approximately 11,000,000, of whom about 7,600,000, or two-thirds of the total

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The work was conducted under the joint auspices of the Bureau of Agricultural Economics, of the United States Department of Agriculture, and the New York State College of Agriculture, Cornell University.

Appreciation is expressed to Dr. Leland Spencer, of Cornell University, for assistance in planning the study and for criticism of the manuscript. Dr. O. C. Stine and Dr. E. E. Vial, of the Bureau of Agricultural Economics, also made helpful suggestions.

[1] A survey of truck receipts of milk and cream at the New York market. By L. F. Champlin and A. J. Pollard. U. S. Agr. Dept., Bur. Agr. Econ. Mimeographed rept. 1939.

[2] Report of the Joint Legislative Committee to Investigate the Milk Industry. New York legislative document no. 114, p. 33. April 10, 1933.

number, reside in New York City. The city includes five boroughs: The Bronx, Manhattan, Queens, Brooklyn, and Richmond.

GRADES OF MILK AND TYPES OF PACKAGES

At the time this study was made the New York City Department of Health recognized the following grades of milk: Certified, Grade A, and Grade B. Grade B is by far the most important (table 1). Certified milk is produced and handled under the supervision of a county medical society, approved by the Department of Health of the city of New York.

Both Grade A and Grade B milk are produced and handled under strict sanitary standards. The following are the principal differences between the two grades of milk. A somewhat lower maximum bacteria count is required for Grade A milk. Grade A milk must be delivered to the consumer within 36 hours after pasteurization, as compared with 48 hours for Grade B milk. The butterfat content of Grade A milk is above that of Grade B milk. Producers of Grade A milk are paid substantial premiums for milk of low bacteria count and high butterfat content. The night's milk must be cooled to 50° F. or lower immediately after milking. The morning's milk must be cooled likewise unless delivered before 8 o'clock. The corresponding requirements for Grade B milk are 60° F. and 9:00 a. m. A cap covering the entire lip of the bottle is required for Grade A but not for Grade B milk. On retail routes Grade A milk is regularly priced at 3 cents a quart higher than Grade B milk.

Quarts are by far the most common unit of sale. Milk in pint or half-pint bottles is usually priced higher than the equivalent amount in quart bottles. Nearly all the Certified and Grade A milk is sold in glass bottles. Grade B milk is sold principally in glass bottles, but a substantial amount is sold in paper containers. Restaurants formerly purchased quantities of Grade B milk in bulk, that is, in cans of various sizes. Since 1938, the serving of bulk milk in restaurants and hotels has been permitted only where dispensing devices approved by the Department of Health have been installed. Because of this, the quantity of bulk-milk sales by dealers was greatly reduced, but is now increasing gradually.

TABLE 1. APPROXIMATE PERCENTAGE OF MILK OF EACH GRADE SOLD IN THE DIFFERENT TYPES AND SIZES OF CONTAINERS IN NEW YORK CITY, 1938*

Grade of milk	Type of container	Size of container			
		Half pint	Pint	Quart	Total
		Per cent			
Certified	Glass bottle	...	...	0.7	0.7
Grade A	Glass bottle	0.3	0.3	13.0	13.6
	Bulk	...	...	0.1	0.1
Grade B	Glass bottle	0.4	0.7	57.0	58.1
	Paper container	0.8	0.3	14.4	15.5
	Bulk	...	...	12.0	12.0
Total	All types	1.5	1.3	97.2	100.0

*Based on reports of milk dealers to the New York City Department of Health.

Since November 13, 1939, a considerable amount of milk, both Grade A and Grade B, has been sold on retail routes in 2-quart paper containers. The 1-quart paper containers are used almost exclusively in the store trade.

A further classification of Grade B milk sold through stores is made, unofficially, into "advertised" and "unadvertised" brands. The "advertised" brands are mainly those of the two large retail companies. There are something like 150 dealers who supply stores with milk of "unadvertised" brands.

MILK AND CREAM RECEIPTS

Receipts of milk and cream at the New York market are used as a measure of consumption of milk and cream. Because of the great size of this market and comparatively light production in the immediate vicinity, the quantity of milk delivered directly from farms is relatively small and changes little from year to year. With some commodities, such as butter, the volume of shipments to market is closely correlated with the volume of production. This is not true with receipts of milk at the New York market, since the industry is so organized that the excess over the current market demand is withheld for conversion into by-products at country plants. The quantity of milk that is reshipped to outlying places or used on ships or dining cars is insignificant in proportion to the whole supply.

Milk receipts at the New York market increased steadily at about the same rate as did population in the metropolitan area from 1900 until 1918 (figure 1). Following 1918, receipts increased at a more rapid rate than did population, reaching a peak in 1930. A sharp drop occurred after 1930, and continued for four years. There was a small increase in 1935, and marked increases in 1936 and 1937. Slight increases in receipts occurred in 1938 and 1939. Presumably population in the area continued to increase after 1930 so that per capita receipts decreased even more than did total receipts during the business depression. The estimated consumption of milk per capita was about the same in 1939 as in 1925.

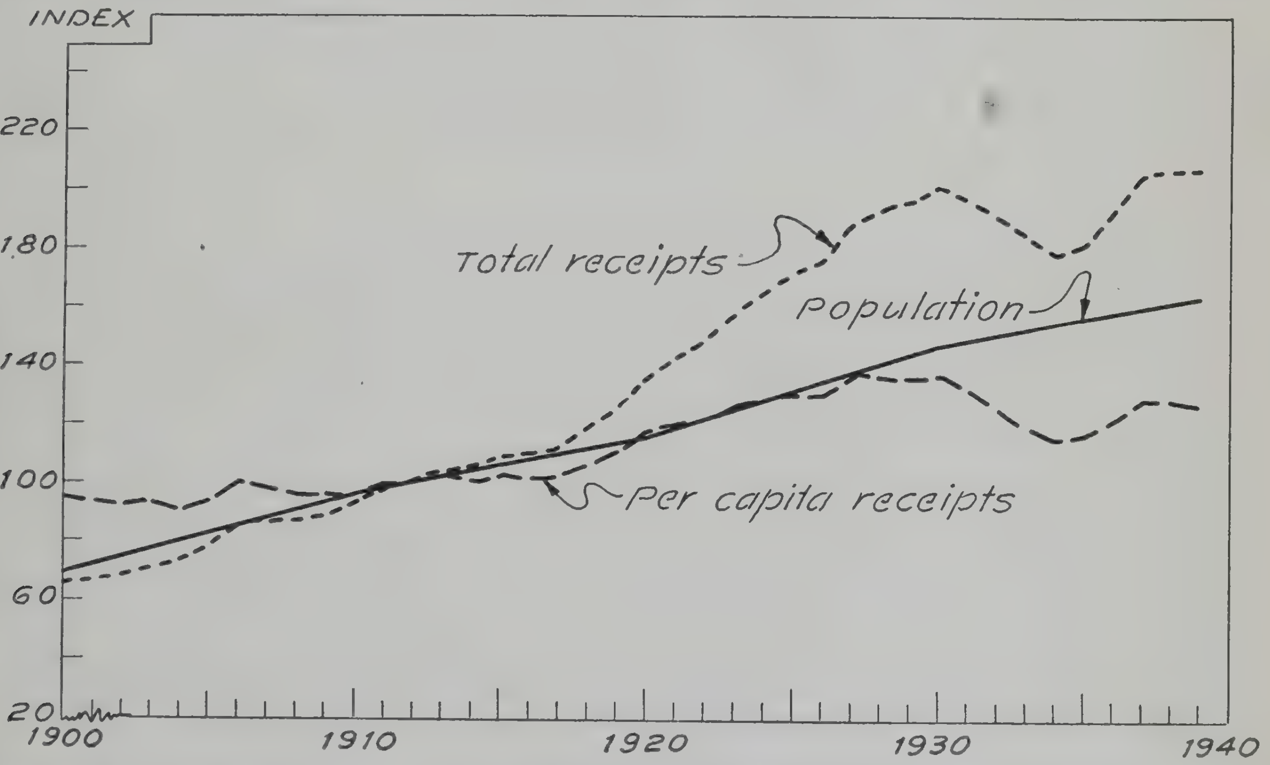

FIGURE 1. RECEIPTS OF MILK IN THE NEW YORK METROPOLITAN AREA (1910–14 = 100)

Not all the cream received at the New York market goes direct to the consumers for table use. A considerable part of it, perhaps 25 per cent, is used in the manufacture of ice cream and cream cheese. The amount used for manufacture probably fluctuates more than that for table use.

Total receipts of cream followed a steep upward trend from 1918 to 1931, but the shrinkage in volume during the depression was greater than that for milk. Some increase in cream receipts occurred in 1935 and 1936; declines were registered in 1937 and 1938 with some increase in 1939. Receipts per capita in 1939 were about 3 per cent greater than in 1925 (figure 2).

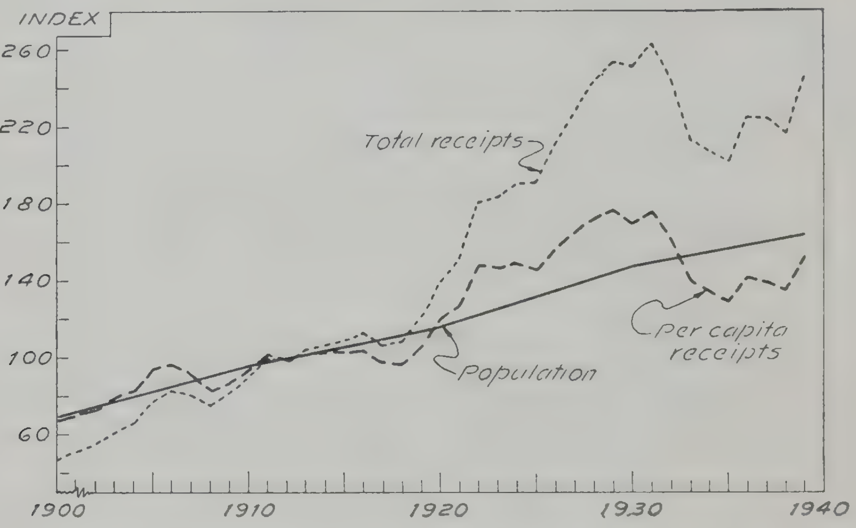

FIGURE 2. RECEIPTS OF CREAM AND PLAIN CONDENSED MILK IN THE NEW YORK METROPOLITAN AREA (1910–14 = 100)

TRENDS IN SALES

Although total receipts of milk at the market may be used as an indication of trends in the total consumption of milk, trends in sales of particular grades of milk or trends in sales through different trade outlets cannot be determined from these data. Since many of the smaller independent companies do not keep complete records of sales, and since it is impossible to obtain the cooperation of all dealers, it is difficult to construct a series of milk sales for all dealers in the market.

Sales data for the larger distributors and for some of the smaller ones were available by grades and types of trade outlet. Total sales by this group of dealers amount to approximately 50 per cent of total milk receipts at the market. These dealers do most of the retail business and handle nearly all of the Grade A milk sold in the market.

In addition to the above data, information was obtained on total sales in Class I (fluid milk) and Class IIA (fluid cream) by 46 "independent" dealers, as reported to the State Division of Milk Control. These dealers sell only Grade B milk and cream, mainly to retail food stores.

GRADE A MILK

Sales of Grade A milk reached a peak in 1930 and continued relatively high until early in 1932 (figure 3). Beginning early in 1932, sales of Grade A milk declined for two years. Grade A sales increased slightly

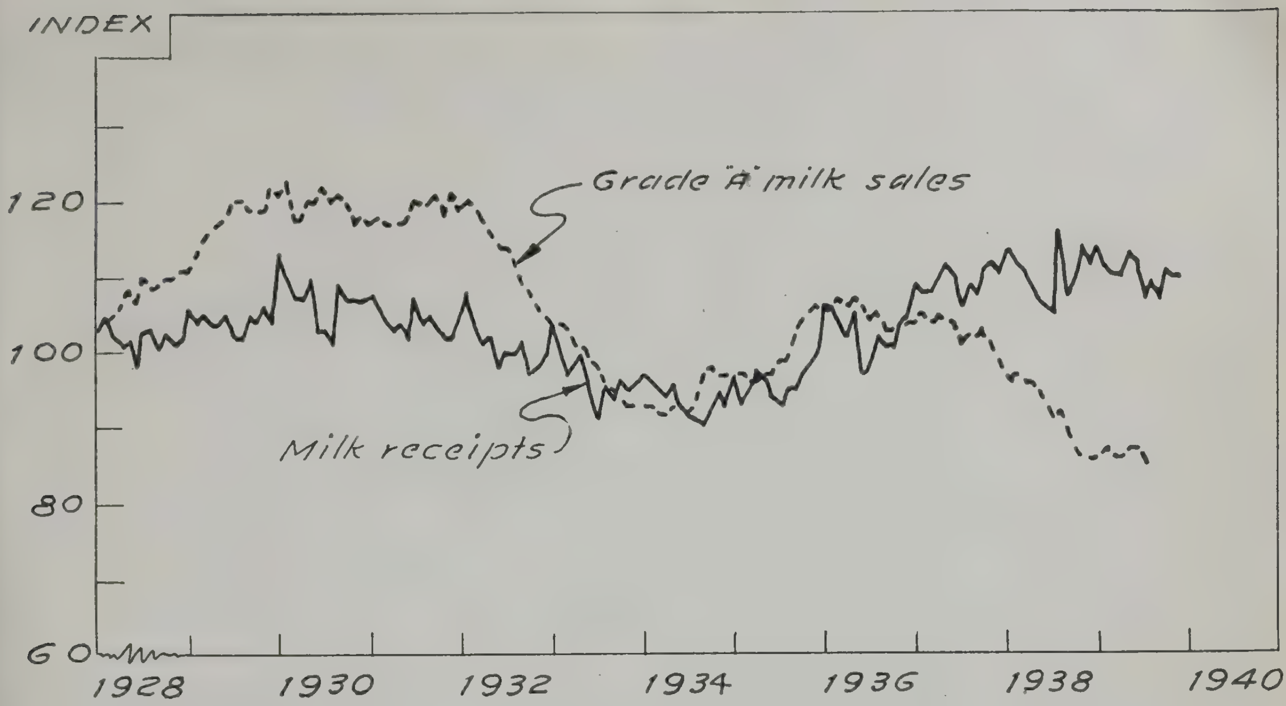

FIGURE 3. DEALERS' SALES OF GRADE A MILK, AND TOTAL RECEIPTS OF MILK IN THE NEW YORK MARKET (1933–37 = 100)

in 1934, and with the introduction of Vitamin D Grade A milk in 1935 there was a further substantial rise. After 1935, however, Grade A sales failed to increase so rapidly as total receipts at the market. In 1937, with the introduction of Vitamin D Grade B milk, sales of Grade A declined and have since continued on a downward trend.

GRADE B MILK

Grade B milk sales have fluctuated with total receipts of milk at the market (figure 4). Most of the sales included in this index were made in New York City, and comparatively few in the suburban areas.

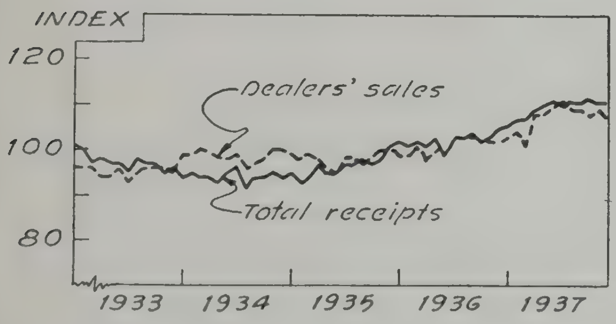

FIGURE 4. DEALERS' SALES OF GRADE B MILK, AND TOTAL RECEIPTS OF MILK IN THE NEW YORK MARKET (1933–37 = 100)

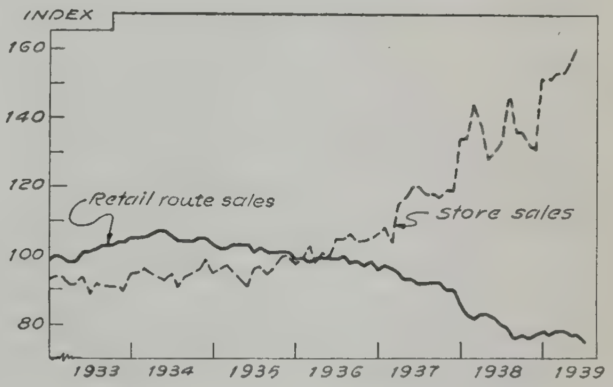

FIGURE 5. DEALERS' SALES OF GRADE B MILK TO FAMILY TRADE AND TO RETAIL FOOD STORES IN THE NEW YORK MARKET (1933–37 = 100)

Trends in dealers' sales of Grade B milk on retail routes and through retail food stores are shown in figure 5. Sales of Grade B milk on retail routes increased through most of 1933 and 1934. During the summer of 1934, the trend in sales on retail routes was reversed and continued downward throughout the period of the study. Sales through retail food stores declined slightly in the early part of 1933, but increased in the fall. There was a slight upward trend in sales through retail food stores prior to 1937. Since 1937, sales through stores have increased materially, and have become more variable.

The most important factor affecting the trend in sales of Grade B milk on retail routes, as compared with sales at retail food stores, is the difference in price charged for the two types of service. From 1933 through April 1937, "unadvertised" brands of Grade B milk were priced 2 cents per quart lower than was Grade B milk delivered to the doorstep. In January 1934, the State Division of Milk Control suspended regulations governing prices at stores. The difference in price was increased for a short period. This resulted in an increase in sales of Grade B milk at stores. The 2-cent differential was reestablished in the spring of 1934 and remained in effect through March 1937. At that time, all price-fixing by the State was discontinued, and Grade B milk sold at stores at prices considerably under the doorstep-delivery price. This wide differential caused a sharp increase in store sales.

The importance of different trade outlets in the total sales of milk are shown in table 2.

TABLE 2. APPROXIMATE DISTRIBUTION OF MILK SALES IN NEW YORK CITY, BY TRADE OUTLET AND TYPE OF CONTAINER, DECEMBER 1938

Trade outlet	Type of container	1938*
		Per cent
Family trade, retail routes	Glass bottle	41
Stores	Glass bottle	30
	Paper container	16
Restaurants, schools, etc.	Bulk and bottled	13
Total	All types	100

*Based on reports of milk dealers to the New York City Department of Health and on supplementary data obtained direct from dealers.

Prices of Grade B milk on retail routes and at stores for a number of years are given in table 3. Prior to 1933 most of the milk sold at stores was loose milk, which was 3 to 5 cents a quart cheaper than milk delivered at the doorstep. In 1933, a commission appointed by the Commissioner of Health of New York City reported that the sale of loose milk was a health hazard, and it was prohibited after June 1, 1933.[3] After the discontinuance of loose milk, bottled milk at stores was priced about 2 cents lower than was milk sold on retail routes. In 1937, the difference was nearly 3 cents. In 1938, "unadvertised" brands of milk at stores averaged nearly 4 cents cheaper than milk delivered at the doorstep. In 1939, the spread was lowered to slightly more than 3 cents.

HEAVY CREAM

The importance of different grades and trade outlets in the total sales of cream are given in table 4. More than half of the cream is now sold through stores, and about 35 per cent is sold to restaurants, hotels, hospitals, and the like.

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[3] Is loose milk a health hazard? Report of the Milk Commission, Department of Health, New York City, November 1931.

TABLE 3. PRICES OF GRADE B MILK ON RETAIL ROUTES AND AT RETAIL FOOD STORES IN NEW YORK CITY

Year	Doorstep-delivery price	Store price	Difference
	Cents per quart		
1925–29	15.4	10.7*	4.7
1930	15.8	10.7*	5.1
1931	14.7	10.4*	4.3
1932	11.9	8.9*	3.0
1933	11.1	9.1†	2.0
1934	12.6	10.5†	2.1
1935	13.0	11.0†	2.0
1936	13.1	11.0†	2.1
1937	12.6	9.7†	2.9
1938	13.1	9.4†	3.7
1939	13.4	10.1†	3.3

*Loose milk.
†"Unadvertised" brands.

Nearly two-thirds of the sweet cream sold in the city is heavy cream, containing about 40 per cent butterfat. Less than one-tenth is medium cream, and the remainder is light cream, containing about 20 per cent butterfat. Nearly all the sweet cream for home consumption is of the "heavy" grade. Most of the light cream and all of the medium cream is sold to hotels and restaurants.

TABLE 4. APPROXIMATE DISTRIBUTION OF SALES OF SWEET CREAM IN NEW YORK CITY, BY TRADE OUTLET AND GRADE, DECEMBER 1938*

Trade outlet	Grade of cream			
	Light	Medium	Heavy	Total
	Per cent			
Family trade, retail routes	1.4	. . .	6.4	7.8
Stores	2.3	. . .	55.2	57.5
Restaurants, hotels, etc.	23.5	9.5	1.7	34.7
Total	27.2	9.5	63.3	100.0

*Based on reports of milk dealers to the New York City Department of Health, and supplementary data obtained direct from dealers.

Dealers' sales of heavy cream did not decline so rapidly as did total receipts of cream in the market during the early years of the period studied (figure 6). Also, the sales recorded did not reach so low a level as did total cream receipts, nor have they shown so much recovery in the past few years. Sales of heavy cream, as represented in this index, were mainly for home consumption, while, as previously stated, total cream receipts include cream used in the manufacture of ice cream and that used by restaurants, hotels, and the like. The sharp decline in receipts of cream in November 1937 was due to a cream shortage in the milkshed, with the result that certain demands in the market were not supplied.

Dealers' sales of cream to retail food stores fell off sharply during 1933 (figure 7). From January 1934 through 1937, there was little variation in the sales of cream either on the retail routes or at stores.

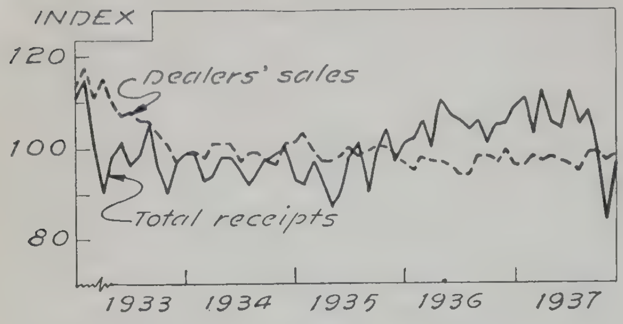

FIGURE 6. DEALERS' SALES OF HEAVY CREAM, AND TOTAL RECEIPTS OF CREAM IN THE NEW YORK MARKET (1933–37 = 100)

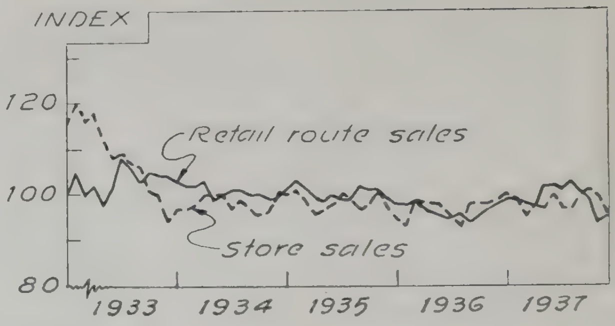

FIGURE 7. DEALERS' SALES OF HEAVY CREAM TO FAMILY TRADE AND TO RETAIL FOOD STORES IN THE NEW YORK MARKET (1933–37 = 100)

SEASONAL VARIATION IN SALES[4]

Seasonal variation in sales of milk and cream in the New York market are caused chiefly by two factors: the movement of large numbers of people out of the metropolitan area for vacations, and the major temperature changes of the passing seasons. These factors act in opposition, since both the per capita consumption of milk and the number of persons going away on vacations increase as midsummer approaches. The sales of different products and of the same products in different types of packages and through different trade outlets are affected in varying degrees by the seasons, depending on the relative quantities used by different groups of consumers.

In the following discussion, comparisons are made with the results of a similar study covering the period 1920-24.[5] Two factors have resulted in a marked change in the seasonal-variation curves; decreased sales caused by the curtailed purchasing power of a large proportion of con-

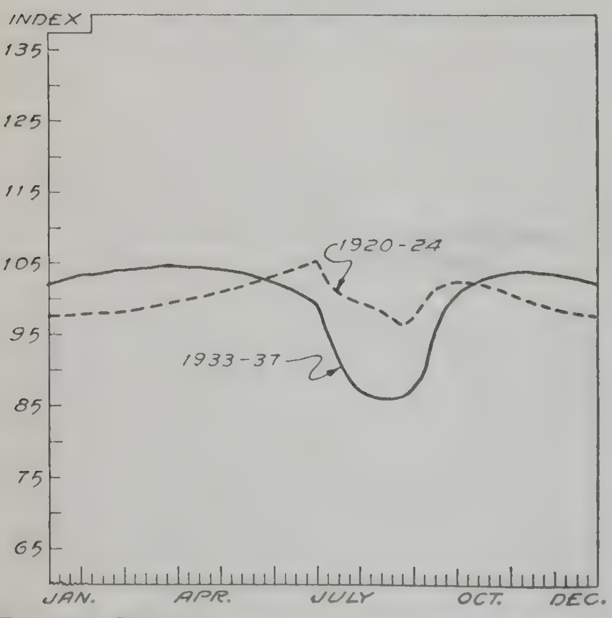

FIGURE 8. SEASONAL VARIATION IN DEALERS' RETAIL SALES OF QUARTS OF GRADE B MILK

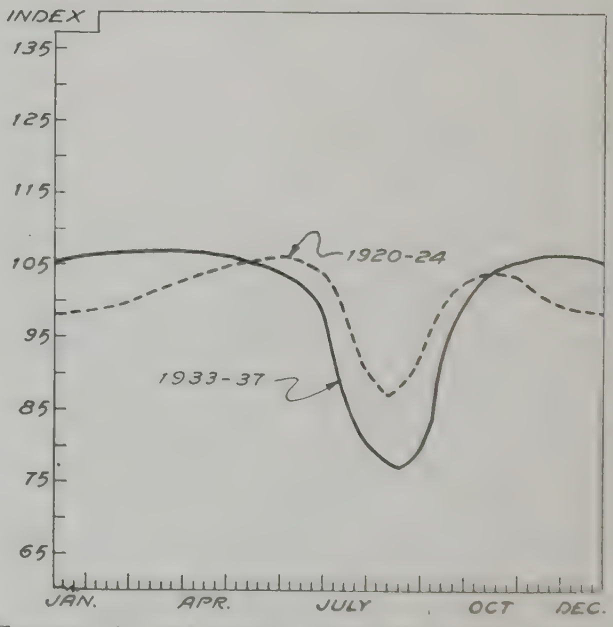

FIGURE 9. SEASONAL VARIATION IN DEALERS' RETAIL SALES OF QUARTS OF GRADE A MILK

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[4] Seasonal variation was calculated as follows: sales during each week were expressed as a percentage of a 52-weeks moving average centered on the 26th week. The percentages for corresponding weeks of the several years were then averaged and plotted. A smooth curve was fitted to these data and the seasonal index read from the smooth curve.

[5] The demand side of the New York milk market. By H. A. Ross, Cornell Univ. Agr. Exp. Sta. Bul. 459. 1927.

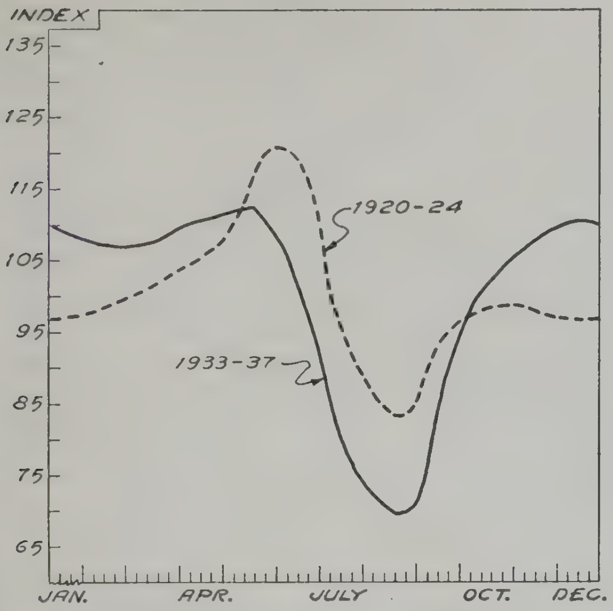

FIGURE 10. SEASONAL VARIATION IN DEALERS' RETAIL SALES OF HEAVY CREAM

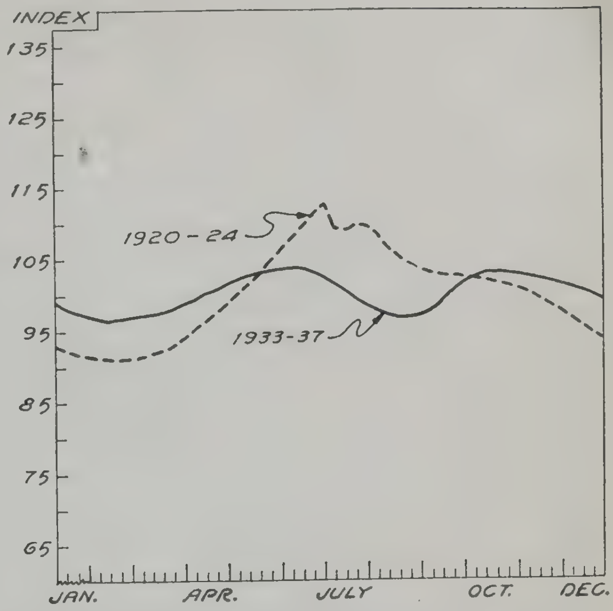

FIGURE 11. SEASONAL VARIATION IN DEALERS' RETAIL SALES OF PINTS OF GRADE B MILK

sumers, and the shift of patronage from retail routes to retail food stores by a large number of families, particularly those in the low-income group.

Seasonal variations in dealers' retail sales of quarts of Grade B milk, Grade A milk, heavy cream, and pints of Grade B milk are shown in figures 8 to 11. In each case it is noticeable that sales during the summer months show a greater decline in the later period; also that sales begin to fall off earlier in the summer and do not return to the normal level until later in the fall. Probably the families concerned are a more select group, and a smaller proportion of them lack the incomes that are necessary for vacations outside the city. Another probable reason is that the vacation habit is more general than it was at the time the earlier study was made.

Seasonal variation in dealers' sales of quarts of Grade B milk, Grade A milk, and heavy cream to retail food stores are shown in figures 12

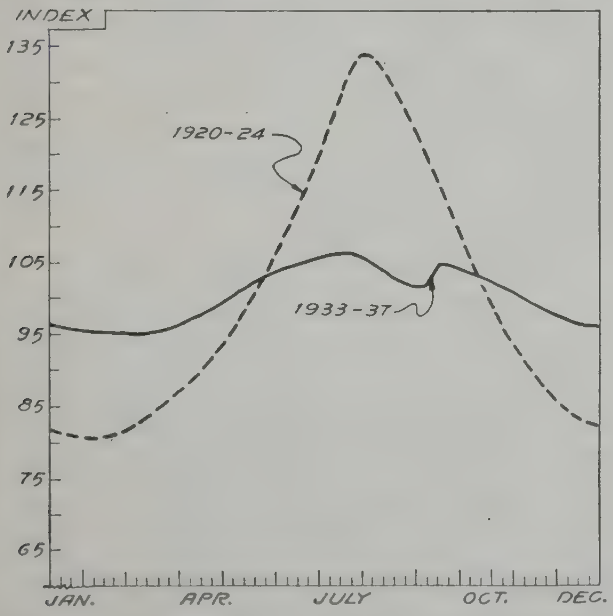

FIGURE 12. SEASONAL VARIATION IN DEALERS' SALES OF QUARTS OF GRADE B MILK TO RETAIL FOOD STORES

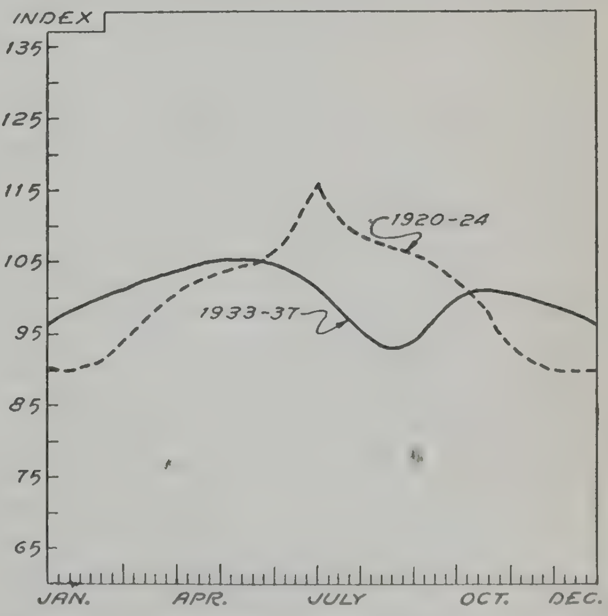

FIGURE 13. SEASONAL VARIATION IN DEALERS' SALES OF QUARTS OF GRADE A MILK TO RETAIL FOOD STORES

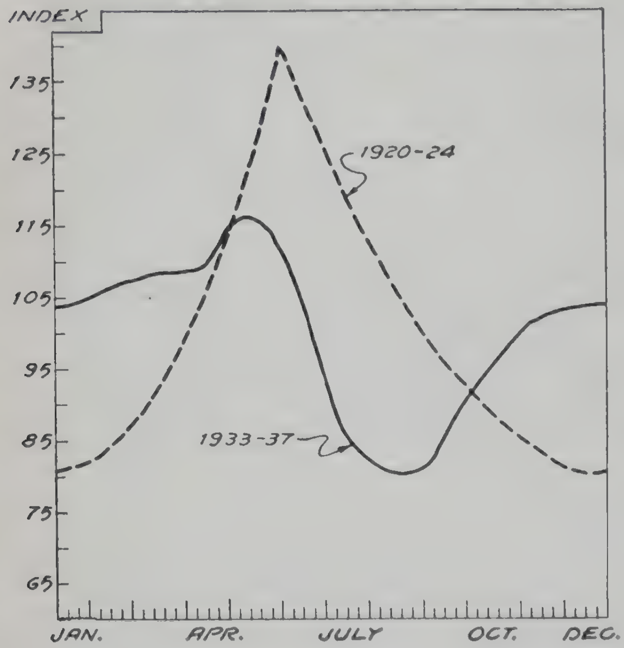

FIGURE 14. SEASONAL VARIATION IN DEALERS' SALES OF HEAVY CREAM TO RETAIL FOOD STORES

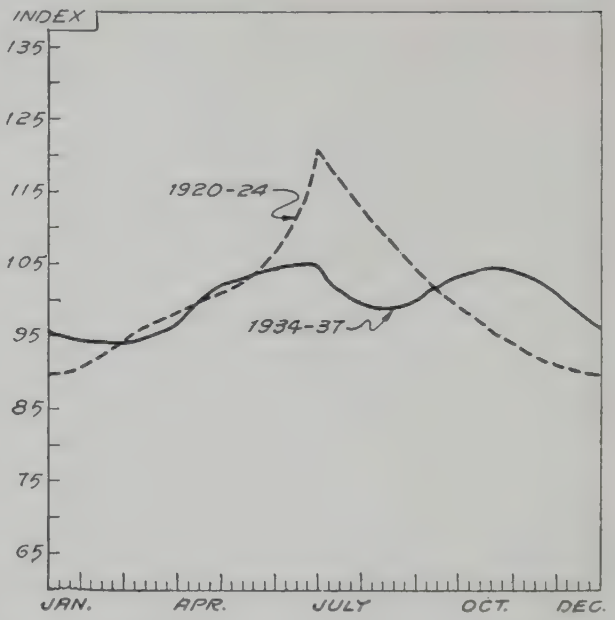

FIGURE 15. SEASONAL VARIATION IN DEALERS' SALES OF GRADE B BULK MILK

to 14. For each product it is noticeable that vacation movements appear to have had a significant effect on sales during the later period, although in the previous study there was little evidence of this. Seasonal-variation curves for dealers' sales to stores in the recent period are similar to the curves for retail-route sales in the earlier period.

Seasonal variation in dealers' sales of Grade B bulk milk for the two periods is shown in figure 15. Bulk-milk sales in the earlier period were made largely to retail food stores for resale to family trade. This was discontinued in 1933. Bulk-milk sales since that time have been made to restaurants, hotels, hospitals, and the like. The serving of bulk milk in restaurants and hotels was discontinued April 1, 1938, except where dispensing devices, approved by the Department of Health, were installed. Because of this the quantity of bulk milk sold by dealers was greatly reduced, but is now increasing gradually.

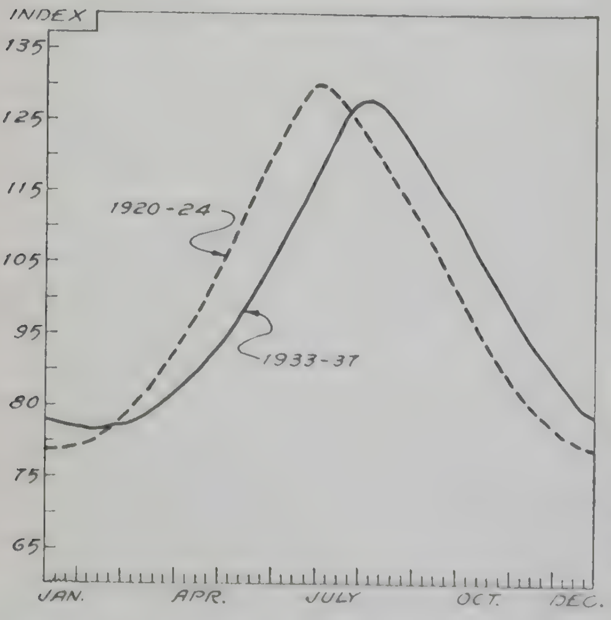

FIGURE 16. SEASONAL VARIATION IN DEALERS' WHOLESALE SALES OF PINTS OF GRADE B MILK

There has been little change in the seasonal variation in dealers' wholesale sales of pints of Grade B milk and dealers' retail and wholesale sales of buttermilk (figures 16 to 18). These products are purchased mainly by adult workers for lunch. Such sales are materially affected by changes in temperature, since these consumers shift from hot beverages to cooler drinks in hot weather.

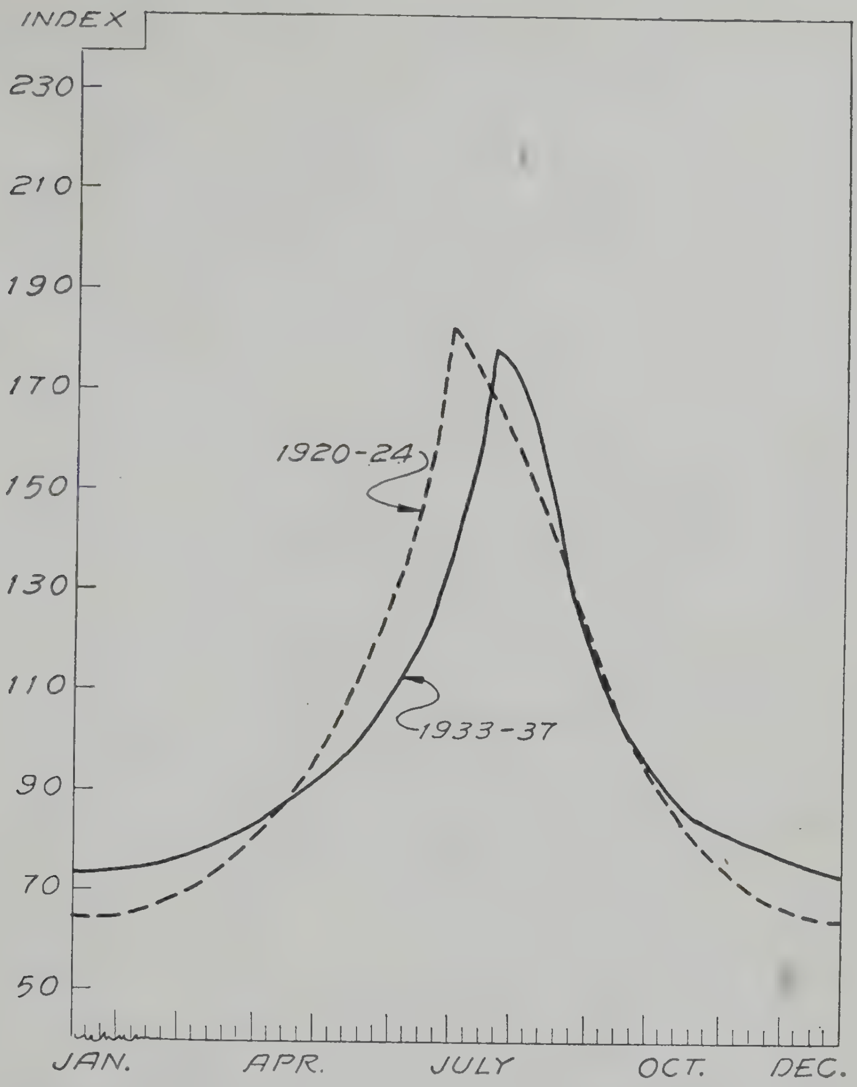

FIGURE 17. SEASONAL VARIATION IN DEALERS' RETAIL SALES OF BUTTERMILK

DAY-OF-THE-WEEK VARIATIONS IN SALES[6]

Because many retail food stores are closed all or part of Sunday, milk and cream sales on Sunday are low in relation to weekday sales, but are high on Saturday and Monday (table 5).

TABLE 5. DAY-OF-THE-WEEK VARIATION IN DEALERS' SALES OF MILK AND CREAM TO RETAIL FOOD STORES IN 1937

Item	Day of the week							
	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Average
	Per cent of average for all days of the week							
Grade A milk	63.9	104.7	106.8	100.0	101.0	108.0	115.6	100.0
Grade B milk in glass bottles	77.7	106.1	102.2	101.5	103.1	102.1	107.3	100.0
Grade B milk in paper containers	75.4	101.7	100.3	103.3	104.3	101.9	113.1	100.0
Heavy cream, bottled	36.3	116.4	103.0	96.3	98.2	107.2	142.6	100.0
Heavy cream, bulk	68.0	106.3	100.2	98.1	97.2	107.1	123.1	100.0

Day-of-the-week variation in store sales of the several products is shown graphically in figures 19 to 23. The differences are due largely to the variation in quantities sold in different types of stores and in areas of different nationality and income. For example, Grade B milk in paper containers and bottled heavy cream were sold more largely by chain stores and in areas of relatively high family incomes; on the other hand, Grade B milk in glass bottles and bulk heavy cream were sold more largely by independent stores and in the low-income areas.

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[6] This discussion pertains only to dealers' sales to retail food stores. For day-of-the-week variations in sales on retail routes, see *The Demand Side of the New York Milk Market*, p. 39-44, by H. A. Ross. (Cornell Univ. Agr. Exp. Sta., Bul. 459, 1927).

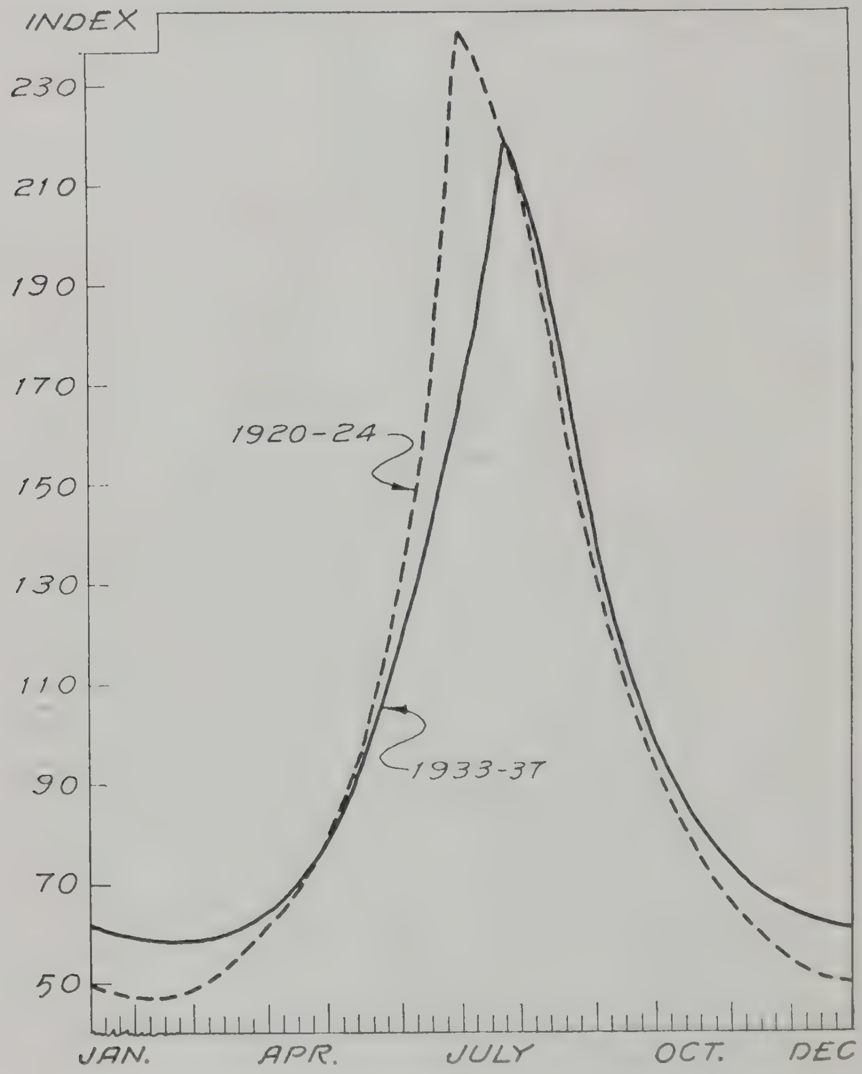

FIGURE 18. SEASONAL VARIATION IN DEALERS' WHOLESALE SALES OF BUTTERMILK

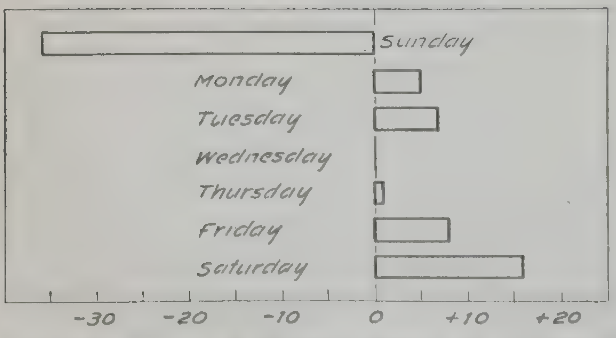

FIGURE 19. DAY-OF-THE-WEEK VARIATION IN DEALERS' SALES OF GRADE A MILK TO RETAIL FOOD STORES

Sales for each day of the week are expressed as percentage above or below average daily sales for the week

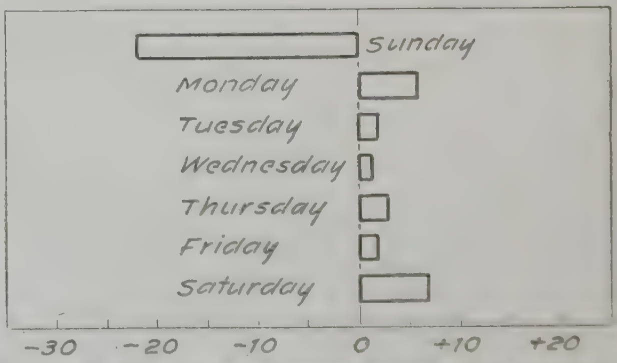

FIGURE 20. DAY-OF-THE-WEEK VARIATION IN DEALERS' SALES OF GRADE B MILK IN GLASS BOTTLES TO RETAIL FOOD STORES

Sales for each day of the week are expressed as percentage above or below average daily sales for the week

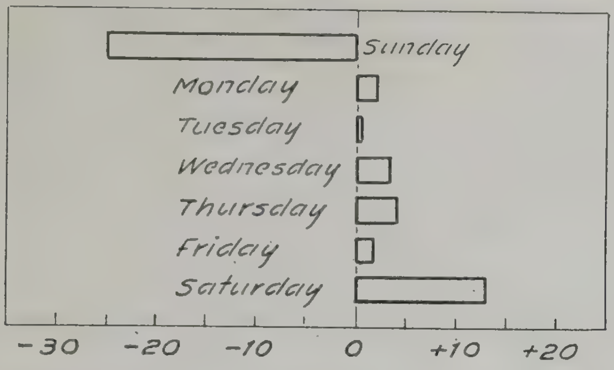

FIGURE 21. DAY-OF-THE-WEEK VARIATION IN DEALERS' SALES OF GRADE B MILK IN PAPER CONTAINERS TO RETAIL FOOD STORES

Sales for each day of the week are expressed as percentage above or below average daily sales for the week

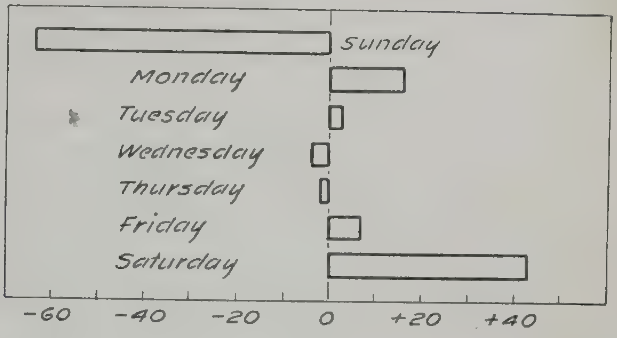

FIGURE 22. DAY-OF-THE-WEEK VARIATION IN DEALERS' SALES OF HEAVY CREAM IN HALF-PINT BOTTLES AND CONTAINERS TO RETAIL FOOD STORES

Sales for each day of the week are expressed as percentage above or below average daily sales for the week

A survey of retail food stores, made in June 1938, revealed that Sunday closing is more general among the chain stores and in areas of medium and high family incomes (tables 6 and 7).[7]

TABLE 6. PROPORTION OF THE DIFFERENT TYPES OF STORES IN NEW YORK CITY THAT WERE KEPT OPEN ON SUNDAY, JUNE 1938

Type of store	Proportion of the stores—			
	Closed all day Sunday	Open part of day Sunday	Open all day Sunday	Total
	Per cent			
Independent grocery store	33.7	49.7	16.6	100.0
Chain grocery store	99.0	0.6	0.4	100.0
Independent dairy store	48.1	42.5	9.4	100.0
Chain dairy store	100.0	....	....	100.0
Dairy stand	57.1	40.3	2.6	100.0
Delicatessen	6.0	62.9	31.1	100.0
Retail bakery shop	7.2	48.2	44.6	100.0
Other*	41.9	48.4	9.7	100.0
All stores	45.9	39.4	14.7	100.0

*Restaurants, soda fountains, etc., where milk is sold to be taken away; also includes a few grocery stands in the public markets.

TABLE 7. PROPORTION OF RETAIL FOOD STORES THAT WERE KEPT OPEN ON SUNDAY IN DIFFERENT INCOME AREAS OF NEW YORK CITY, JUNE 1938

Income areas	Proportion of the stores—			
	Closed all day Sunday	Open part of day Sunday	Open all day Sunday	Total
	Per cent			
Low	34.5	45.6	19.9	100.0
Medium	52.2	37.5	10.3	100.0
High	63.0	22.2	14.8	100.0
All areas	45.9	39.4	14.7	100.0

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[7] Sales of milk by retail food stores in the New York market, June 1938. By Charles Blanford. Cornell Univ., Dept. Agr. Econ. A. E. 237 [mimeographed] 1939.

HOLIDAY VARIATIONS IN SALES[8]

Variations in sales of milk and cream due to holidays are of three types: decreased sales of some products on holidays which permit a portion of the population to leave town; increased sales of some products on holidays such as Thanksgiving and Christmas; increased or decreased sales on various religious holidays.

The variations in dealers' sales of Grade B milk and heavy cream to retail food stores due to holidays in 1937 are shown in tables 8 and 9.

TABLE 8. EFFECT OF HOLIDAYS ON DEALERS' SALES OF GRADE B MILK TO RETAIL FOOD STORES, 1937*

Holiday	Day of week on which holiday occurred	Second day previous	Previous day	Holiday	Following day	Second day following
		Per cent				
New Year's Day	Friday	99.7	103.2	81.8	98.5	99.3
Lincoln's Birthday	Tuesday	99.3	100.7	95.9	98.4	101.4
Washington's Birthday	Friday	97.8	101.0	91.6	99.1	99.2
Purim	Thursday	99.1	99.2	98.8	96.7	95.6
Passover	....	97.6	102.5	85.8†	101.8	101.3
Easter	Sunday	‡	94.6	87.9	102.7	101.9
Memorial Day	Sunday (observed on Monday)	107.1	98.7	95.7	82.8	106.6
Independence Day	Sunday (observed on Monday)	92.3	87.9	86.3	71.3	97.0
Labor Day	Monday	106.7	137.0	52.8	81.7	104.6
Yom Kippur	Wednesday	103.3	103.6	65.3	93.2	92.1
Thanksgiving	Thursday	104.0	106.4	85.2	93.4	95.7
Christmas	Saturday	100.0	103.4	75.9	88.4	92.2

*Sales on day of the holiday are expressed as a percentage of the average daily sales for the same day of the week during the month in which the holiday occurred.
†Average for the period of Passover.
‡Conflicts with day before beginning of Passover.

TABLE 9. EFFECT OF HOLIDAYS ON DEALERS' SALES OF HEAVY CREAM TO RETAIL FOOD STORES, 1937*

Holiday	Day of week on which holiday occurred	Second day previous	Previous day	Holiday	Following day	Second day following
		Per cent				
New Year's Day	Friday	102.0	117.1	70.4	97.9	80.4
Lincoln's Birthday	Tuesday	93.9	106.8	110.0	97.1	112.5
Washington's Birthday	Friday	96.9	109.5	89.2	102.0	94.8
Purim	Thursday	102.0	94.8	105.2	105.0	90.6
Passover	....	96.3	108.7	89.0†	102.3	99.4
Easter	Sunday	‡	91.1	85.5	95.6	105.4
Memorial Day	Sunday (observed on Monday)	104.0	91.4	86.1	51.2	118.9
Independence Day	Sunday (observed on Monday)	100.9	110.9	94.6	70.8	116.0
Labor Day	Monday	84.7	123.8	53.1	80.1	107.9
Yom Kippur	Wednesday	105.2	80.2	77.4	92.8	82.1
Thanksgiving	Thursday	102.8	130.1	91.3	105.0	99.3
Christmas	Saturday	98.8	111.4	63.5	85.3	88.4

*Sales on day of the holiday are expressed as a percentage of the average daily sales for the same day of the week during the month in which the holiday occurred.
†Average for the period of Passover.
‡Conflicts with day before beginning of Passover.

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[8] Variations in retail-route sales due to holidays are discussed in *The Demand Side of the New York Milk Market*, p. 44-47, by H. A. Ross. (Cornell Univ. Agr. Exp. Sta., Bul. 459, 1927).

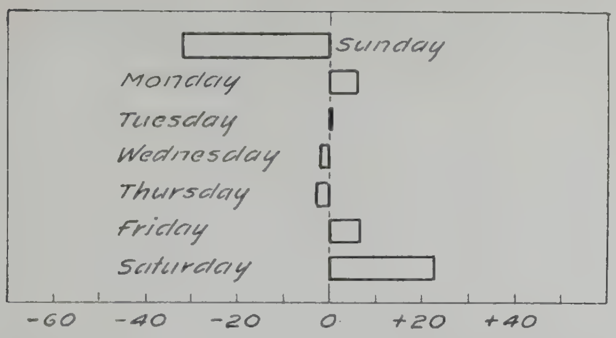

FIGURE 23. DAY-OF-THE-WEEK VARIATION IN DEALERS' SALES OF HEAVY CREAM IN BULK TO RETAIL FOOD STORES

Sales for each day of the week are expressed as percentage above or below average daily sales for the week

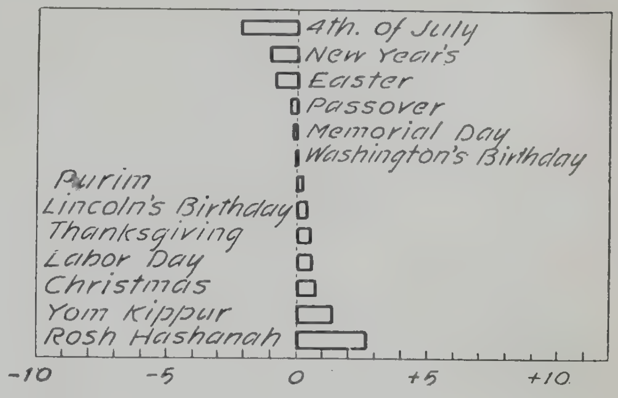

FIGURE 24. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF QUARTS OF GRADE B MILK TO FAMILY TRADE

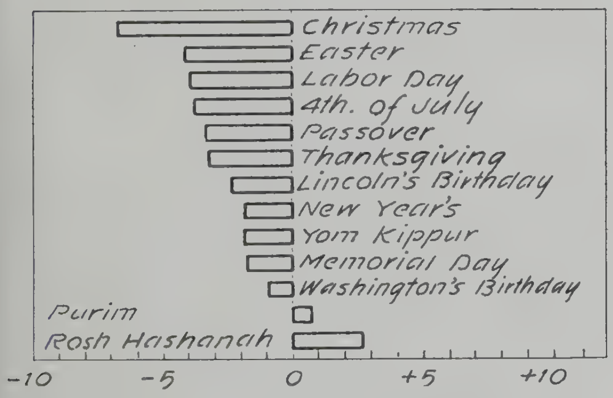

FIGURE 25. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF QUARTS OF GRADE B MILK TO RETAIL FOOD STORES

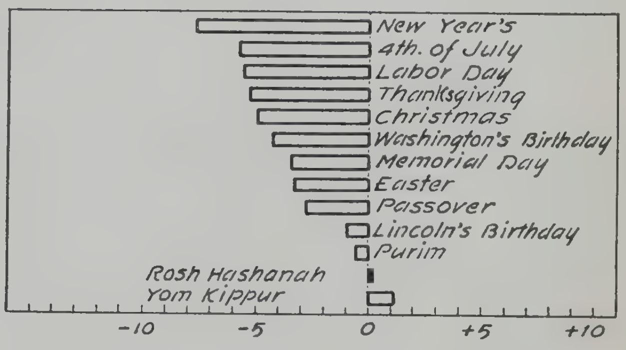

FIGURE 26. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF PINTS OF GRADE B MILK TO FAMILY TRADE

Milk sales at stores were low on all holidays, but were particularly low on holidays, such as Memorial Day, the Fourth of July, and Labor Day, which occurred on Saturday or Monday, thus permitting a large number of people to be out of town for a weekend. In general, cream sales were affected more by holidays than were the sales of milk.

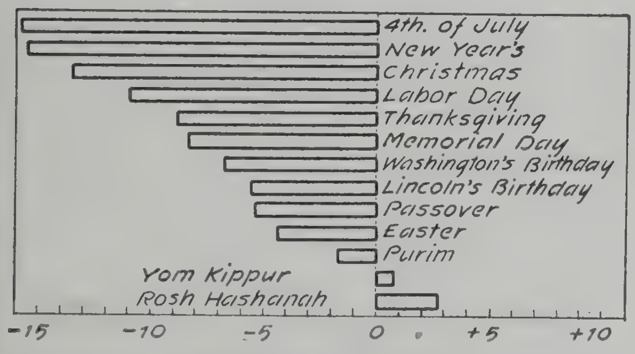

FIGURE 27. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF PINTS OF GRADE B MILK TO RETAIL FOOD STORES

The effects of holidays on sales of the various products during the week when the holiday occurred are shown in figures 24 to 33.[9] These data give a more nearly accurate measure of the effect of holidays on sales because they are for five years, as contrasted with only one year for the daily sales.

Dealers' retail sales of quarts of Grade B milk are only slightly affected by holidays. The greatest decrease in sales was 2.2 per cent during the week of July 4. The greatest increase was 2.7 per cent during the week of Rosh Hashanah, the Jewish New Year.

With two exceptions, dealers' sales of quarts of Grade B milk to retail food stores decreased in weeks in which holidays occurred. The greatest

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[9] Sales during the weeks in which holidays occurred were expressed as percentage change from the average weekly sales during the previous three weeks.

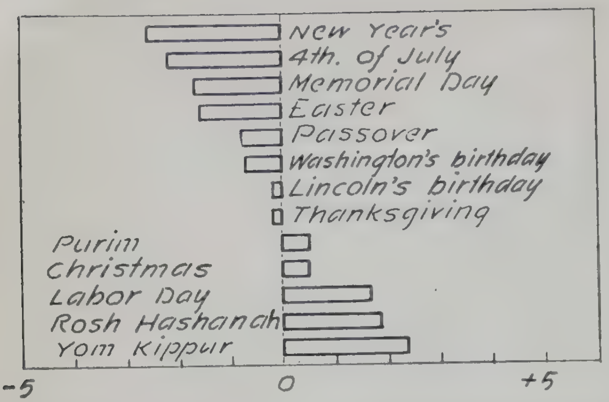

FIGURE 28. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF GRADE A MILK TO FAMILY TRADE

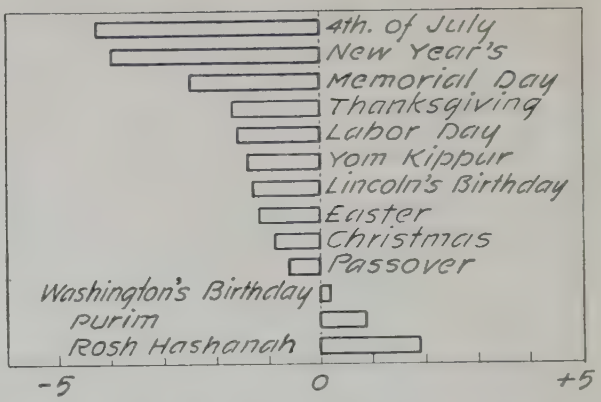

FIGURE 29. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF GRADE A MILK TO RETAIL FOOD STORES

decrease occurred during Christmas week. The only weeks in which there was an increase were the weeks of Purim and Rosh Hashanah.

Sales of pints of Grade B milk, both to family trade[10] and to retail food stores, were smaller in all weeks in which holidays occurred, except for Yom Kippur and Rosh Hashanah. The decrease in store sales was nearly twice as great in each case as the decrease in retail sales. As pointed out earlier, pints are purchased mainly by adults for luncheon. Since many of these consumers do not work on holidays, sales of this product decrease materially.

The effect of holidays on Grade A milk sales to family trade and to retail food stores was slight. Grade A milk is consumed primarily by children, whose consumption habits vary little from day to day.

Dealers' retail sales of heavy cream were greater in all but four weeks in which holidays occurred. Sales of cream during Thankgiving week were nearly 20 per cent greater than normal cream sales.

Dealers' sales of heavy cream to retail food stores were less affected by holidays. There was a decrease in store sales of cream during seven of the thirteen weeks studied. The difference in effect of holidays on retail and store sales of heavy cream is explained by the differences in income status of consumers purchasing from the two sources. The families taking cream from retail routes belong mostly to the high-income group, while more of those buying at stores have only medium or low incomes.

Both retail and wholesale sales of buttermilk decreased in nearly all

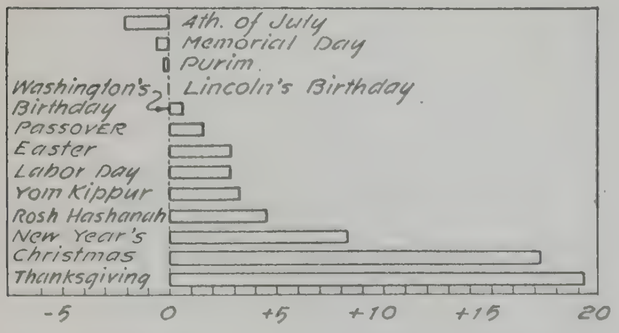

FIGURE 30. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF HEAVY CREAM TO FAMILY TRADE

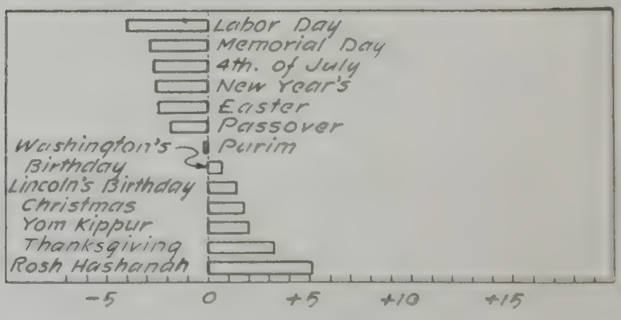

FIGURE 31. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF HEAVY CREAM TO RETAIL FOOD STORES

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[10] Sales to family trade include sales in offices, on construction jobs, and the like.

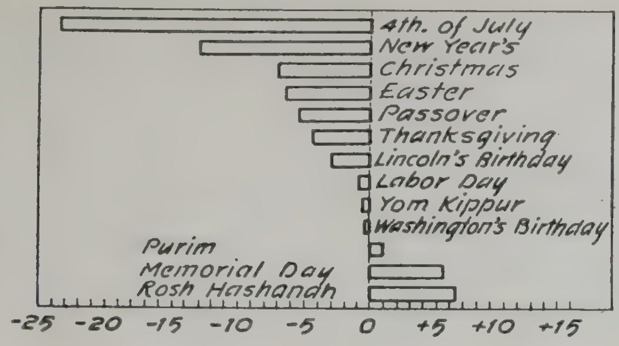

Figure 32. effect of holidays on dealers' weekly sales of buttermilk to family trade

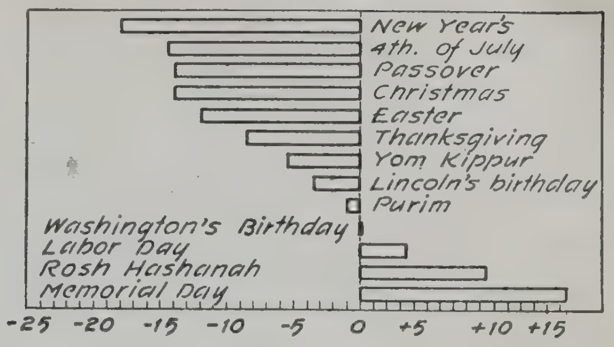

Figure 33. effect of holidays on dealers' weekly sales of buttermilk to stores and restaurants

weeks in which holidays occurred.[11] As pointed out earlier, buttermilk is consumed primarily by adults for lunch. Since many of these consumers do not work on holidays, sales of buttermilk decrease in weeks in which holidays occur.

VARIATIONS IN SALES DUE TO PRICE CHANGES

The effect of price changes on the sales of milk is very difficult to measure statistically. The available data on weekly sales pertain only to the larger milk distributors. Their total sales are heavily weighted by retail-route sales to consumers with relatively high incomes and by sales to chain food stores which also are patronized by families whose incomes are well above the average. Also, it is difficult to eliminate changes in sales which represent shifts in business among dealers. During the period studied, as pointed out earlier, there was a considerable shift of milk sales from retail routes to retail food stores. It is difficult to establish continuous and accurate series of data for either sales or prices for milk at retail food stores.

The method of analysis that is used here to determine variations in sales due to price changes shows primarily the short-time effects. The longer-time effects are even more difficult to measure.

From April 1933 to April 1937, the retail prices of milk in New York City were set by the Division of Milk Control. In April 1937, state price-fixing in New York was discontinued. Prices in the New Jersey section of the market were set by the New Jersey Milk Control Board throughout the entire period studied.

During the period covered by this study (1933-37), the price of milk in New York City was raised 1 cent per quart, or about 7 to 10 per cent, seven times, and was lowered a like amount three times. In New Jersey, the price was increased 1 cent per quart five times, and lowered a like amount twice.

Although the data are too variable to justify definite conclusions, it is apparent that a 1-cent increase in the price of milk caused only a very slight reduction in sales, considerably less than 1 per cent. Likewise a 1-cent reduction in price brought less than 2 per cent increase in sales during the first week. No significant effects can be traced beyond the second week (figures 34 and 35). Consumer response to price changes of 1 cent per quart in the price of milk apparently was no greater during this period of relatively low consumer purchasing power than during

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[11] Retail sales include sales in offices, on construction jobs, and the like.

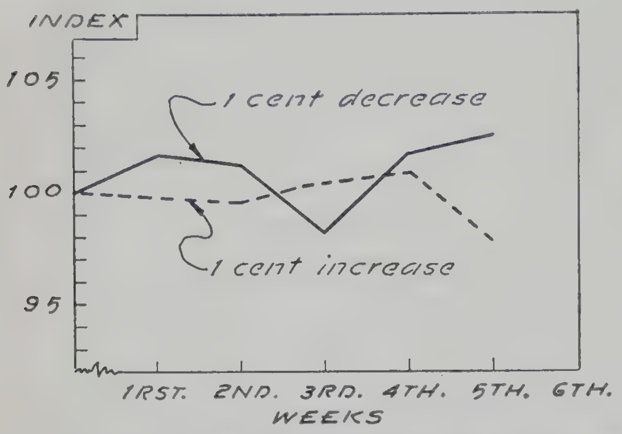

FIGURE 34. EFFECT OF PRICE CHANGES OF ONE CENT PER QUART ON DEALERS' TOTAL SALES OF GRADE B MILK IN NEW YORK CITY

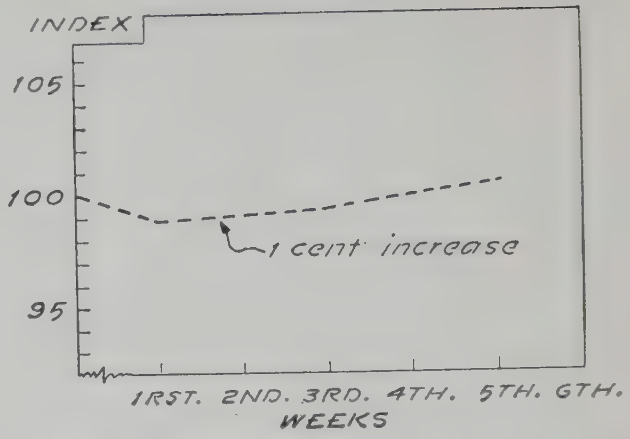

FIGURE 35. EFFECT OF PRICE CHANGES OF ONE CENT PER QUART ON DEALERS' TOTAL SALES OF GRADE B MILK IN NEW JERSEY

the period studied by Ross, which was a period of relatively high consumer purchasing power.[12]

Cream prices were raised 1 cent per half pint, or about 5 per cent, seven times in New York City during the period studied, and were reduced a like amount twice.

The 1-cent increases in the price of cream appear to have had a significant effect on the sales of cream, but the reduction was only about 2 per cent (figures 36 and 37).

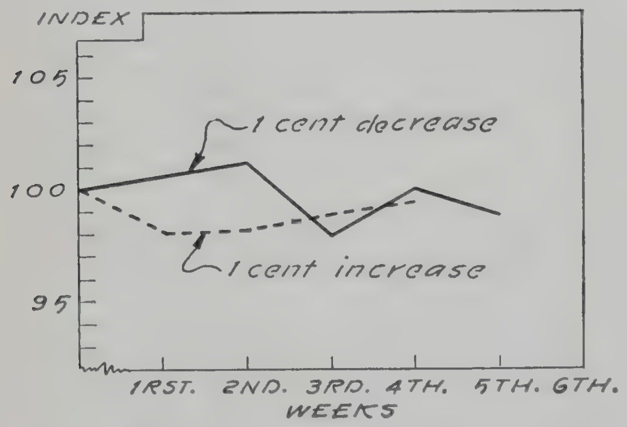

FIGURE 36. EFFECT OF PRICE CHANGES OF ONE CENT PER HALF PINT ON DEALERS' TOTAL SALES OF HEAVY CREAM IN NEW YORK CITY

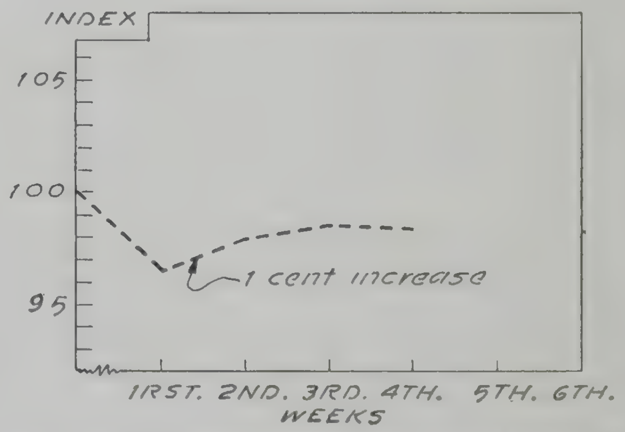

FIGURE 37. EFFECT OF PRICE CHANGES OF ONE CENT PER HALF PINT ON DEALERS' TOTAL SALES OF HEAVY CREAM IN NEW JERSEY

There were five increases of 2 cents in the price of cream in New Jersey, and this amount of increase apparently caused a marked reduction in sales (figure 38). Likewise, decreases of 2 cents in the price of cream resulted in somewhat larger sales.

Price increases of 3 cents per half pint in both New York City and New Jersey resulted in very marked decreases in sales of heavy cream (figures 39 and 40).

VARIATION IN SALES DUE TO CHANGES IN BUSINESS CONDITIONS

One of the most important factors affecting sales of milk and cream generally over a period of time is the purchasing power of consumers.

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[12] Ross, H. A. The demand side of the New York milk market. Cornell Univ. Agr. Exp. Sta. Bul. 459. 1927.

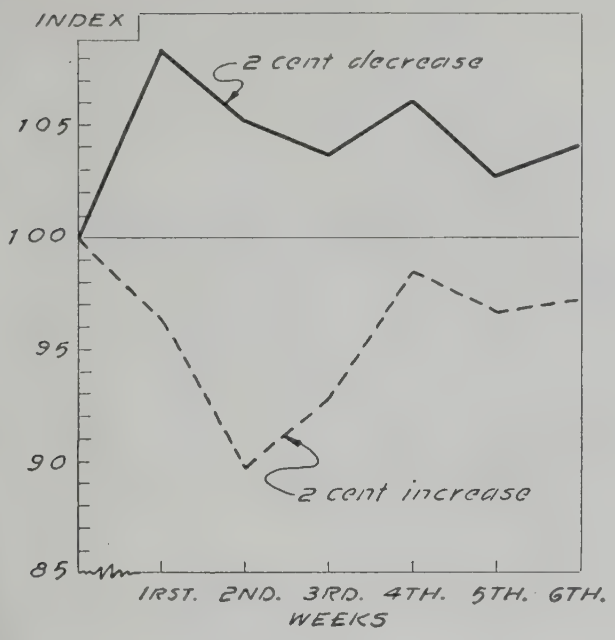

FIGURE 38. EFFECT OF PRICE CHANGES OF TWO CENTS PER HALF PINT ON DEALERS' TOTAL SALES OF HEAVY CREAM IN NEW JERSEY

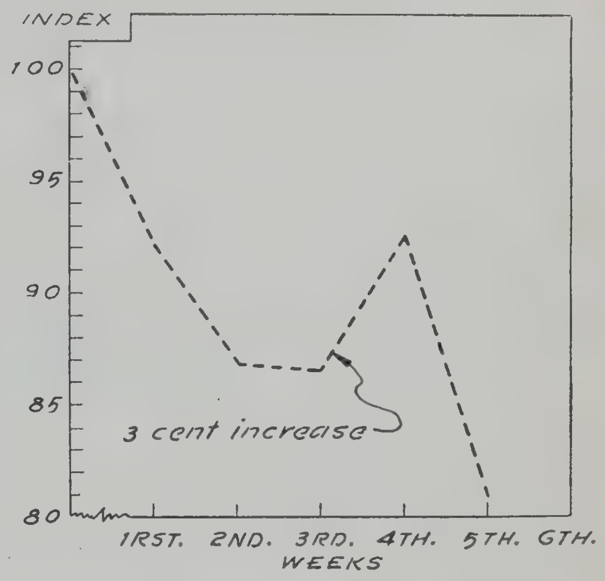

FIGURE 39. EFFECT OF PRICE CHANGES OF THREE CENTS PER HALF PINT ON DEALERS' TOTAL SALES OF HEAVY CREAM IN NEW YORK CITY

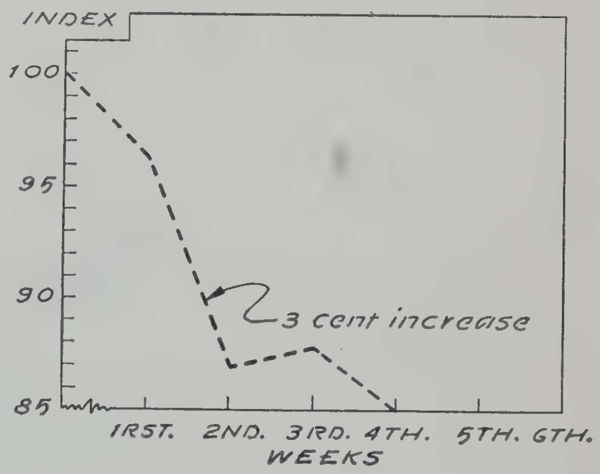

FIGURE 40. EFFECT OF PRICE CHANGES OF THREE CENTS PER HALF PINT ON DEALERS' TOTAL SALES OF HEAVY CREAM IN NEW JERSEY

This is true to an even greater extent during a depression than during a period of prosperity.

Changes in milk sales appear to follow about ten months after changes in business activity, as measured by the *New York Times Index,* but the relationship is not very close (figure 41). This index reflects business conditions throughout the country rather than those in New York City particularly. The Federal Reserve Bank of New York publishes, in its *Monthly Review of Credit and Business Conditions,* an indication of department-store sales in New York and Brooklyn. Changes in milk receipts at the New York market follow this index of department-store sales with a lag of five months (figure 42).[13] Although there is a general relationship between milk receipts and business activity over a period of time, milk receipts do not have the violent changes that are characteristic of business activity as measured by the *New York Times Index* and by the index of department-store sales.

Receipts of cream at the market appear to follow New York and Brooklyn department-store sales with a lag of ten months (figure 43). In 1930, and again in 1937, an increase in department-store sales was not followed by increased cream receipts. In 1932, a drop in department-store sales was not followed by a decrease in cream receipts.

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[13] Department-store sales are a total-value figure, as compared with a physical-volume figure for milk receipts, and thus are affected by variations in prices as well as by variations in volume.

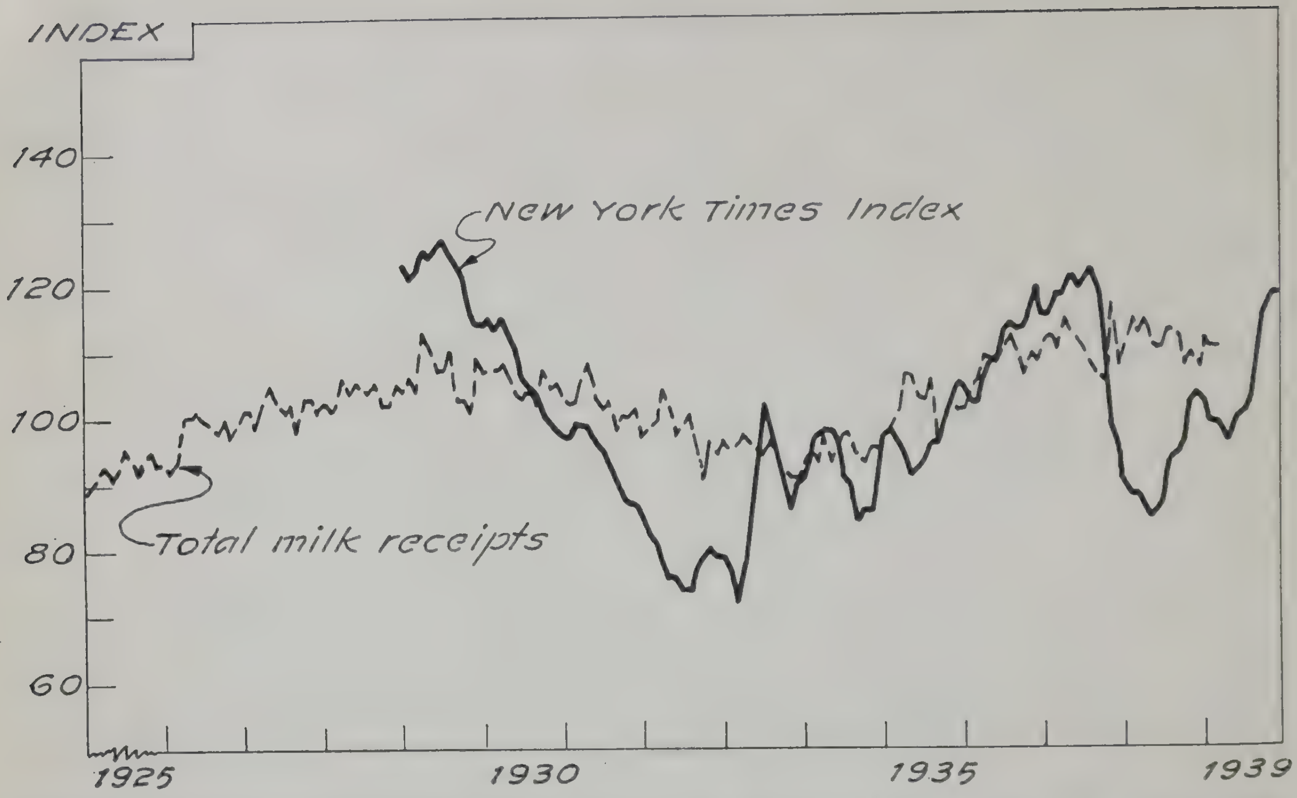

FIGURE 41. TOTAL MILK RECEIPTS AT THE NEW YORK MARKET, AND THE NEW YORK TIMES INDEX OF BUSINESS ACTIVITY TEN MONTHS EARLIER (1933–37 = 100)

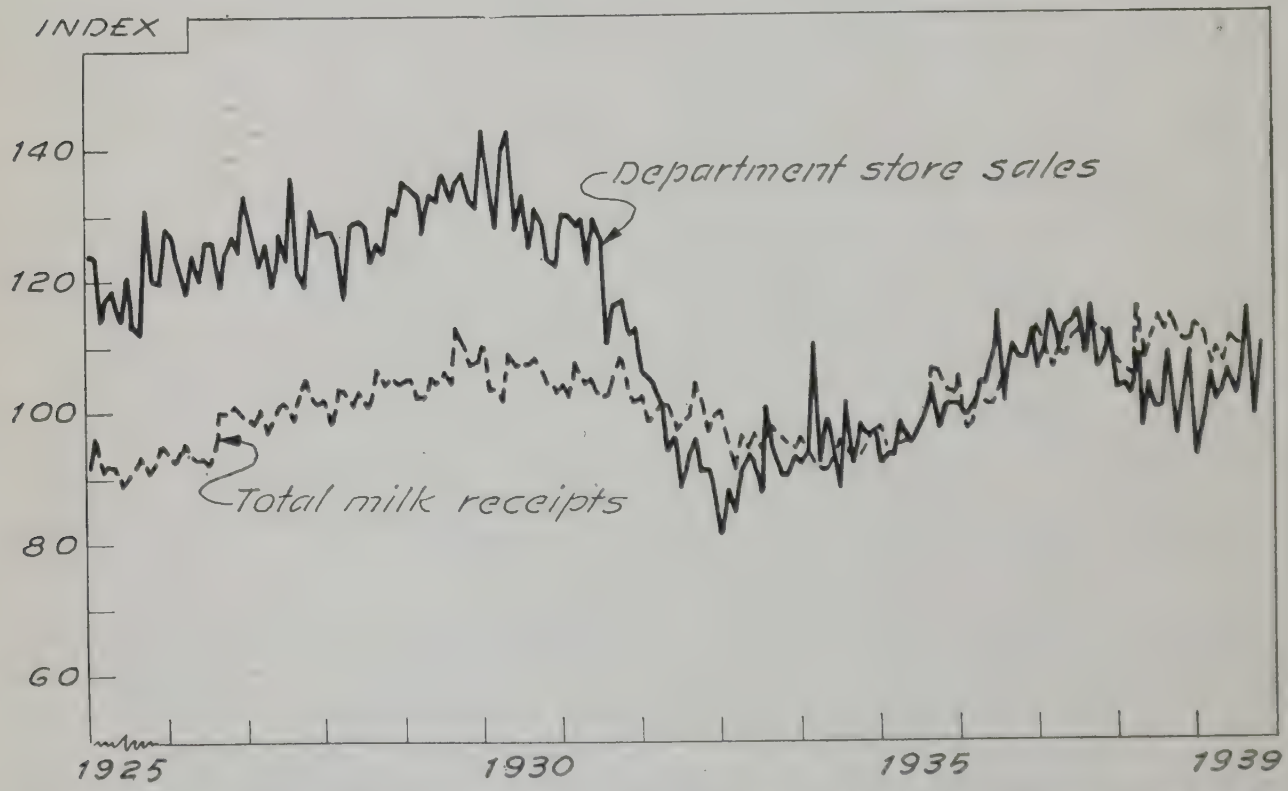

FIGURE 42. TOTAL MILK RECEIPTS AT THE NEW YORK MARKET, AND NEW YORK AND BROOKLYN DEPARTMENT-STORE SALES FIVE MONTHS EARLIER (1933–37 = 100)

SUMMARY AND CONCLUSIONS

Receipts of milk at the New York market, which are a good indication of total milk consumption, increased steadily until 1930. After 1930 there was a sharp falling off in receipts for about four years. The total for 1934 was 12 per cent below that for 1930. Milk receipts again turned upward in 1935. There were marked increases in 1936 and 1937. The receipts during 1939 were greater by 2 or 3 per cent than those of 1930.

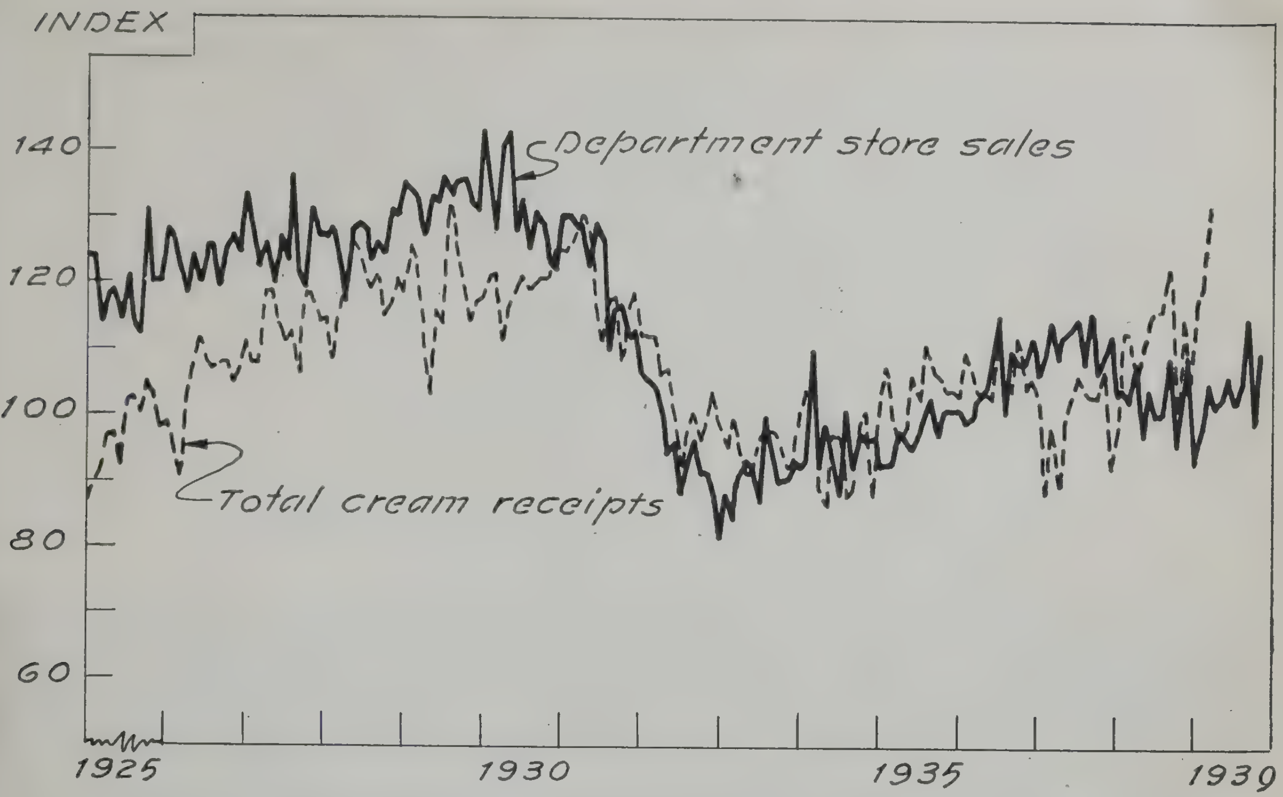

FIGURE 43. TOTAL CREAM RECEIPTS AT THE NEW YORK MARKET, AND NEW YORK AND BROOKLYN DEPARTMENT-STORE SALES TEN MONTHS EARLIER (1933–37 = 100)

but the population of the market area probably had increased about 9 per cent, so that less milk was consumed per capita.

Sales of Grade A milk reached a peak in 1930 and continued relatively high until early in 1932, when they dropped sharply. A slight increase in sales of Grade A occurred in 1934, and with the introduction of Vitamin D Grade A in 1935, sales recovered materially. In 1937, with the introduction of Vitamin D Grade B milk, sales of Grade A milk declined and have since continued on a downward trend.

Total sales of Grade B milk by dealers whose records were used in this study have fluctuated much the same as have the total receipts of milk at the market. Since 1935 the sales of Grade B milk through retail food stores have increased, while sales on retail routes have declined. This change is due to the decreased purchasing power of a large share of the consuming public and to the fact that milk has been sold by stores at lower prices. Since 1935 an increasing proportion of the milk sold through stores has been put up in paper containers, and although this milk has generally been priced 1 cent a quart higher, the greater convenience of the paper container as compared with glass bottles has tended to promote the store method of distribution.

Heavy cream makes up nearly two-thirds of the cream sold in New York City. About half of the cream is handled through retail food stores, and 35 per cent is sold to restaurants, hotels, and the like. Only about 15 per cent is delivered to consumers on retail milk routes. Sales of heavy cream for home consumption by New York City dealers did not fall off so much as did total receipts of cream during the depression, and have not shown as rapid recovery since. Apparently changes in the use of cream for making ice cream and cream cheese have followed a different pattern.

Seasonal variation in sales of milk and cream in the New York market are caused by two factors: the movement of large numbers of people out of the metropolitan area for vacations, and major temperature changes of the passing seasons. These factors act in opposition, since both the per capita consumption of milk and the number of persons going away on vacations increase as midsummer approaches. The sales of different products and of the same products in different types of packages and through different trade outlets are affected in varying degrees by the seasons, depending on the relative quantities used by different groups of consumers. Retail sales of quarts of Grade A milk vary only slightly except for a decrease during the summer months. This product is purchased by families with moderate to high incomes, and is consumed largely by children. The fact that it is consumed largely by children tends to prevent wide fluctuations, but the fact that most of the families buying it are able to go out of the city on long vacations causes a large reduction in sales during the summer months.

On the other hand, the sales of buttermilk increase strikingly during the summer. This product is purchased mainly by adults for lunch, and during the warmer seasons these consumers shift from hot to cold beverages. Relatively few of these consumers are able to be away during the summer for very long periods of time.

Because many retail food stores are closed all or part of Sunday, the store sales of milk and cream on Sunday are low in relation to the sales on other days of the week. This decrease in sales is nearly offset by increased sales on Friday, Saturday, and Monday.

Variations in sales of milk and cream due to holidays are of three types: decreased sales of some products on holidays which permit a portion of the population to leave town; increased sales of some products on holidays such as Thanksgiving and Christmas; increased or decreased sales on various religious holidays.

Changes of 1 cent a quart in the price of Grade B milk, either increase or decrease, appeared to have only a slight effect on the total sales. Because of the confusing effects of other factors, it was not possible to trace the influence of such price changes beyond the second or third week. Likewise, a 1-cent change in the price of half pints of heavy cream had only a slight effect on sales. On the other hand, changes of 2 cents or 3 cents per half pint in the price of cream caused a material increase or reduction in sales.

During the period of this study there were no changes of more than 1 cent in the price of milk on retail routes. There were, however, two occasions, in 1934 and in 1937, when the price of milk at stores declined rather sharply. In each of those instances there was a marked increase in the sales of milk at stores, without much change in the sales on retail routes.

There can be no doubt that the sales of milk and cream are affected to a considerable extent by changes in the consumers' purchasing power. However, the relationship between milk and cream sales and business activity, as measured by the *New York Times Index* or by department-store sales in New York and Brooklyn, is not as close as one might expect. Changes in total milk receipts at the market lagged about ten months behind the changes shown in the *New York Times Index*, and about five months behind changes in department-store sales. Cream receipts appear to lag about ten months behind changes in department-store sales.

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An Analysis of Dealers' Sales of Milk and Cream in the New York Market, 1933-38

Charles J. Blanford

In cooperation with the Bureau of Agricultural Economics of the
United States Department of Agriculture

TYPES OF CONTAINERS USED IN THE NEW YORK MARKET

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AN ANALYSIS OF DEALERS' SALES OF MILK AND CREAM IN THE NEW YORK MARKET, 1933-38

Charles J. Blanford

PURPOSE

The purpose of this study was to analyze fresh-milk and -cream sales in order to determine consumer responses to price changes, business conditions, seasons, and the like, during a period of business depression and recovery.

NATURE AND SOURCES OF THE DATA

Receipts of fresh milk and cream by rail and truck, as reported by the Market News Service of the United States Department of Agriculture, were used to indicate long-time trends in consumption of these products. A special survey was made to obtain more complete data on receipts by motor trucks.[1]

Records of weekly and monthly sales of fresh milk and cream were obtained from the four largest milk distributors in the market, and several of the smaller ones, for the period 1933-38.

Records of sales of fresh milk and cream by all milk distributors in New York City for one day of each quarter in 1937 and 1938 were obtained from the Department of Health of the city of New York.

Data concerning monthly sales in Class I (fluid milk) and Class IIA (fluid cream), during the years 1933-38, by all dealers licensed by the Division of Milk Control of the New York State Department of Agriculture and Markets were made available by that division.

Most of the data analyzed in this study pertain to New York City; however, part of the information, particularly that concerning the retail sales of the larger distributors, pertain to the entire New York metropolitan market.

THE NEW YORK MARKET

The New York metropolitan market is described as follows: "This market lies in two states, New York and New Jersey. As often defined, it also includes a small area in Connecticut. It covers all or a part of seventeen counties, including scores of municipalities, ranging in size from New York City to smaller commuter centers in northern New Jersey, Long Island, and Westchester County".[2]

The population of this metropolitan market is estimated at approximately 11,000,000, of whom about 7,600,000, or two-thirds of the total

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Author's Acknowledgments. The author wishes to acknowledge the cooperation of the larger distributors, including the Dairymen's League, and several of the smaller ones, who made their sales records available for this study.

The work was conducted under the joint auspices of the Bureau of Agricultural Economics, of the United States Department of Agriculture, and the New York State College of Agriculture, Cornell University.

Appreciation is expressed to Dr. Leland Spencer, of Cornell University, for assistance in planning the study and for criticism of the manuscript. Dr. O. C. Stine and Dr. E. E. Vial, of the Bureau of Agricultural Economics, also made helpful suggestions.

[1] A survey of truck receipts of milk and cream at the New York market. By L. F. Champlin and A. J. Pollard. U. S. Agr. Dept., Bur. Agr. Econ. Mimeographed rept. 1939.

[2] Report of the Joint Legislative Committee to Investigate the Milk Industry. New York legislative document no. 114, p. 33. April 10, 1933.

number, reside in New York City. The city includes five boroughs: The Bronx, Manhattan, Queens, Brooklyn, and Richmond.

GRADES OF MILK AND TYPES OF PACKAGES

At the time this study was made the New York City Department of Health recognized the following grades of milk: Certified, Grade A, and Grade B. Grade B is by far the most important (table 1). Certified milk is produced and handled under the supervision of a county medical society, approved by the Department of Health of the city of New York.

Both Grade A and Grade B milk are produced and handled under strict sanitary standards. The following are the principal differences between the two grades of milk. A somewhat lower maximum bacteria count is required for Grade A milk. Grade A milk must be delivered to the consumer within 36 hours after pasteurization, as compared with 48 hours for Grade B milk. The butterfat content of Grade A milk is above that of Grade B milk. Producers of Grade A milk are paid substantial premiums for milk of low bacteria count and high butterfat content. The night's milk must be cooled to 50° F. or lower immediately after milking. The morning's milk must be cooled likewise unless delivered before 8 o'clock. The corresponding requirements for Grade B milk are 60° F. and 9:00 a. m. A cap covering the entire lip of the bottle is required for Grade A but not for Grade B milk. On retail routes Grade A milk is regularly priced at 3 cents a quart higher than Grade B milk.

Quarts are by far the most common unit of sale. Milk in pint or half-pint bottles is usually priced higher than the equivalent amount in quart bottles. Nearly all the Certified and Grade A milk is sold in glass bottles. Grade B milk is sold principally in glass bottles, but a substantial amount is sold in paper containers. Restaurants formerly purchased quantities of Grade B milk in bulk, that is, in cans of various sizes. Since 1938, the serving of bulk milk in restaurants and hotels has been permitted only where dispensing devices approved by the Department of Health have been installed. Because of this, the quantity of bulk-milk sales by dealers was greatly reduced, but is now increasing gradually.

TABLE 1. APPROXIMATE PERCENTAGE OF MILK OF EACH GRADE SOLD IN THE DIFFERENT TYPES AND SIZES OF CONTAINERS IN NEW YORK CITY, 1938*

Grade of milk	Type of container	Size of container			
		Half pint	Pint	Quart	Total
		Per cent			
Certified	Glass bottle	...	...	0.7	0.7
Grade A	Glass bottle	0.3	0.3	13.0	13.6
	Bulk	...	...	0.1	0.1
Grade B	Glass bottle	0.4	0.7	57.0	58.1
	Paper container	0.8	0.3	14.4	15.5
	Bulk	...	...	12.0	12.0
Total	All types	1.5	1.3	97.2	100.0

*Based on reports of milk dealers to the New York City Department of Health.

Since November 13, 1939, a considerable amount of milk, both Grade A and Grade B, has been sold on retail routes in 2-quart paper containers. The 1-quart paper containers are used almost exclusively in the store trade.

A further classification of Grade B milk sold through stores is made, unofficially, into "advertised" and "unadvertised" brands. The "advertised" brands are mainly those of the two large retail companies. There are something like 150 dealers who supply stores with milk of "unadvertised" brands.

MILK AND CREAM RECEIPTS

Receipts of milk and cream at the New York market are used as a measure of consumption of milk and cream. Because of the great size of this market and comparatively light production in the immediate vicinity, the quantity of milk delivered directly from farms is relatively small and changes little from year to year. With some commodities, such as butter, the volume of shipments to market is closely correlated with the volume of production. This is not true with receipts of milk at the New York market, since the industry is so organized that the excess over the current market demand is withheld for conversion into by-products at country plants. The quantity of milk that is reshipped to outlying places or used on ships or dining cars is insignificant in proportion to the whole supply.

Milk receipts at the New York market increased steadily at about the same rate as did population in the metropolitan area from 1900 until 1918 (figure 1). Following 1918, receipts increased at a more rapid rate than did population, reaching a peak in 1930. A sharp drop occurred after 1930, and continued for four years. There was a small increase in 1935, and marked increases in 1936 and 1937. Slight increases in receipts occurred in 1938 and 1939. Presumably population in the area continued to increase after 1930 so that per capita receipts decreased even more than did total receipts during the business depression. The estimated consumption of milk per capita was about the same in 1939 as in 1925.

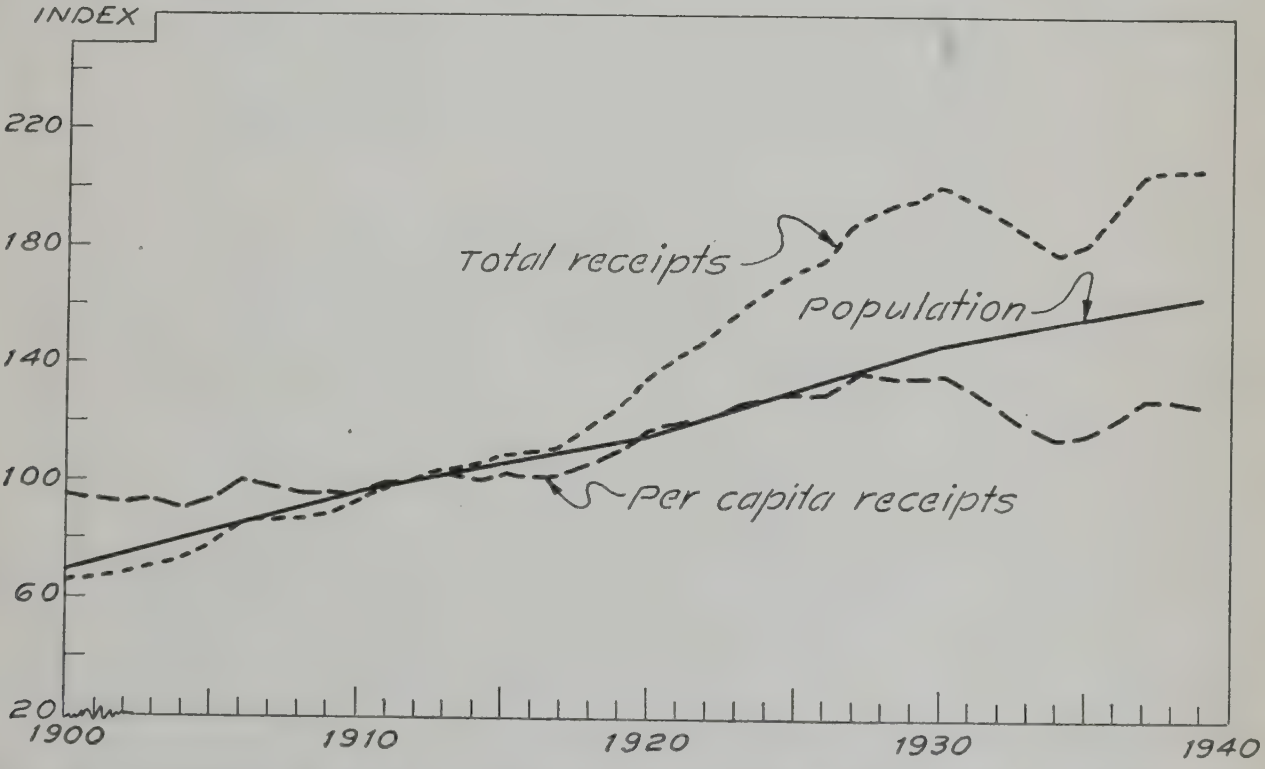

FIGURE 1. RECEIPTS OF MILK IN THE NEW YORK METROPOLITAN AREA (1910–14 = 100)

Not all the cream received at the New York market goes direct to the consumers for table use. A considerable part of it, perhaps 25 per cent, is used in the manufacture of ice cream and cream cheese. The amount used for manufacture probably fluctuates more than that for table use.

Total receipts of cream followed a steep upward trend from 1918 to 1931, but the shrinkage in volume during the depression was greater than that for milk. Some increase in cream receipts occurred in 1935 and 1936; declines were registered in 1937 and 1938 with some increase in 1939. Receipts per capita in 1939 were about 3 per cent greater than in 1925 (figure 2).

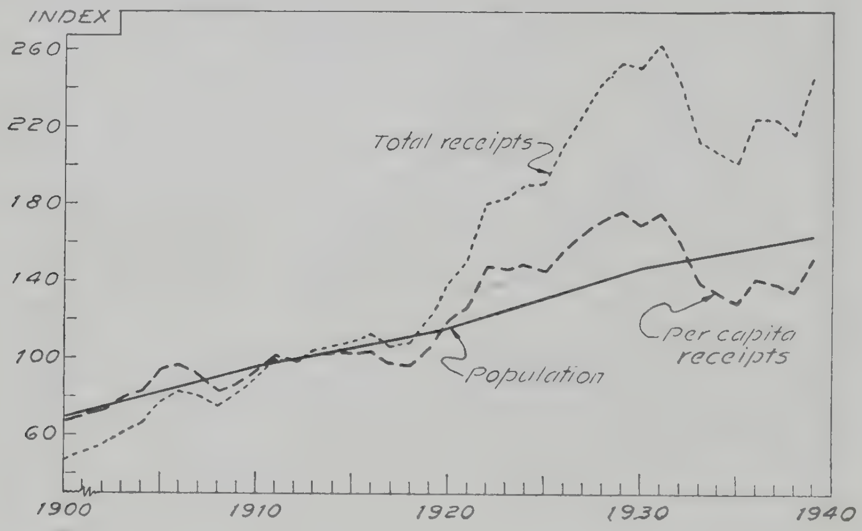

FIGURE 2. RECEIPTS OF CREAM AND PLAIN CONDENSED MILK IN THE NEW YORK METROPOLITAN AREA (1910–14 = 100)

TRENDS IN SALES

Although total receipts of milk at the market may be used as an indication of trends in the total consumption of milk, trends in sales of particular grades of milk or trends in sales through different trade outlets cannot be determined from these data. Since many of the smaller independent companies do not keep complete records of sales, and since it is impossible to obtain the cooperation of all dealers, it is difficult to construct a series of milk sales for all dealers in the market.

Sales data for the larger distributors and for some of the smaller ones were available by grades and types of trade outlet. Total sales by this group of dealers amount to approximately 50 per cent of total milk receipts at the market. These dealers do most of the retail business and handle nearly all of the Grade A milk sold in the market.

In addition to the above data, information was obtained on total sales in Class I (fluid milk) and Class IIA (fluid cream) by 46 "independent" dealers, as reported to the State Division of Milk Control. These dealers sell only Grade B milk and cream, mainly to retail food stores.

GRADE A MILK

Sales of Grade A milk reached a peak in 1930 and continued relatively high until early in 1932 (figure 3). Beginning early in 1932, sales of Grade A milk declined for two years. Grade A sales increased slightly

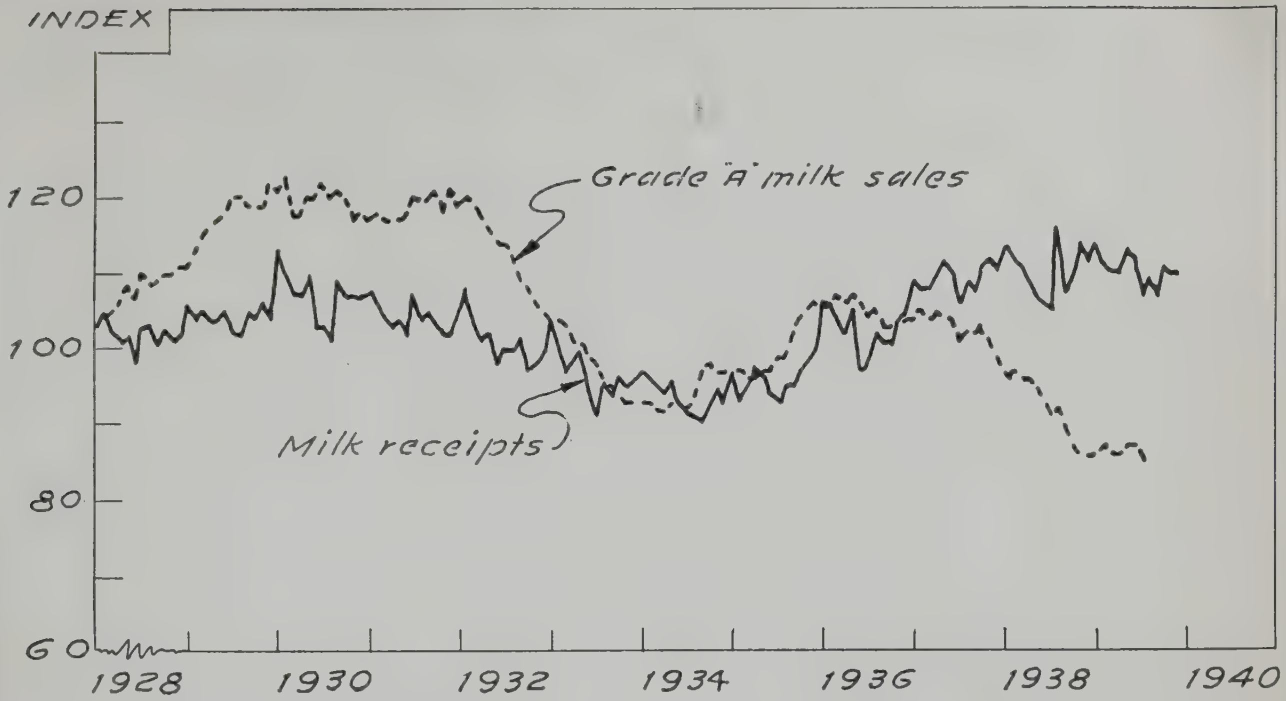

Figure 3. dealers' sales of grade a milk, and total receipts of milk in the new york market (1933–37 = 100)

in 1934, and with the introduction of Vitamin D Grade A milk in 1935 there was a further substantial rise. After 1935, however, Grade A sales failed to increase so rapidly as total receipts at the market. In 1937, with the introduction of Vitamin D Grade B milk, sales of Grade A declined and have since continued on a downward trend.

GRADE B MILK

Grade B milk sales have fluctuated with total receipts of milk at the market (figure 4). Most of the sales included in this index were made in New York City, and comparatively few in the suburban areas.

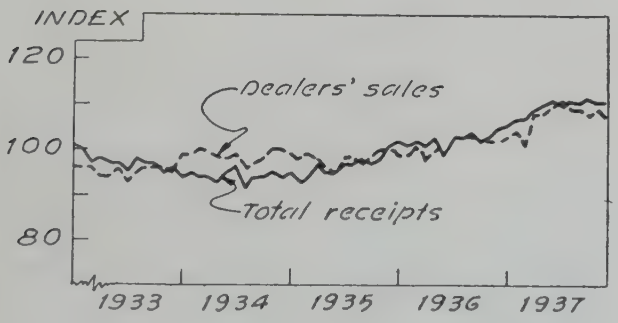

Figure 4. dealers' sales of grade b milk, and total receipts of milk in the new york market (1933–37 = 100)

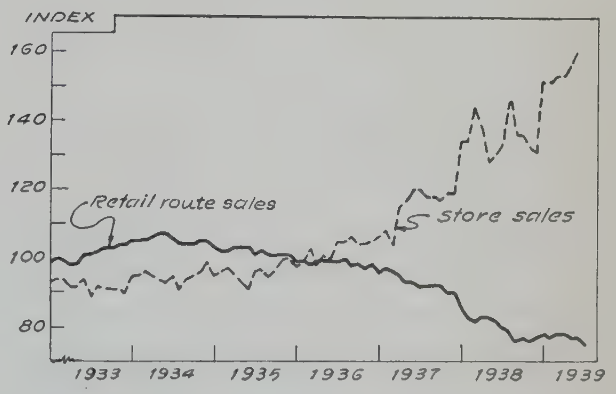

Figure 5. dealers' sales of grade b milk to family trade and to retail food stores in the new york market (1933–37 = 100)

Trends in dealers' sales of Grade B milk on retail routes and through retail food stores are shown in figure 5. Sales of Grade B milk on retail routes increased through most of 1933 and 1934. During the summer of 1934, the trend in sales on retail routes was reversed and continued downward throughout the period of the study. Sales through retail food stores declined slightly in the early part of 1933, but increased in the fall. There was a slight upward trend in sales through retail food stores prior to 1937. Since 1937, sales through stores have increased materially, and have become more variable.

The most important factor affecting the trend in sales of Grade B milk on retail routes, as compared with sales at retail food stores, is the difference in price charged for the two types of service. From 1933 through April 1937, "unadvertised" brands of Grade B milk were priced 2 cents per quart lower than was Grade B milk delivered to the doorstep. In January 1934, the State Division of Milk Control suspended regulations governing prices at stores. The difference in price was increased for a short period. This resulted in an increase in sales of Grade B milk at stores. The 2-cent differential was reestablished in the spring of 1934 and remained in effect through March 1937. At that time, all price-fixing by the State was discontinued, and Grade B milk sold at stores at prices considerably under the doorstep-delivery price. This wide differential caused a sharp increase in store sales.

The importance of different trade outlets in the total sales of milk are shown in table 2.

TABLE 2. APPROXIMATE DISTRIBUTION OF MILK SALES IN NEW YORK CITY, BY TRADE OUTLET AND TYPE OF CONTAINER, DECEMBER 1938

Trade outlet	Type of container	1938*
		Per cent
Family trade, retail routes	Glass bottle	41
Stores	Glass bottle	30
	Paper container	16
Restaurants, schools, etc.	Bulk and bottled	13
Total	All types	100

*Based on reports of milk dealers to the New York City Department of Health and on supplementary data obtained direct from dealers.

Prices of Grade B milk on retail routes and at stores for a number of years are given in table 3. Prior to 1933 most of the milk sold at stores was loose milk, which was 3 to 5 cents a quart cheaper than milk delivered at the doorstep. In 1933, a commission appointed by the Commissioner of Health of New York City reported that the sale of loose milk was a health hazard, and it was prohibited after June 1, 1933.[3] After the discontinuance of loose milk, bottled milk at stores was priced about 2 cents lower than was milk sold on retail routes. In 1937, the difference was nearly 3 cents. In 1938, "unadvertised" brands of milk at stores averaged nearly 4 cents cheaper than milk delivered at the doorstep. In 1939, the spread was lowered to slightly more than 3 cents.

HEAVY CREAM

The importance of different grades and trade outlets in the total sales of cream are given in table 4. More than half of the cream is now sold through stores, and about 35 per cent is sold to restaurants, hotels, hospitals, and the like.

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[3] Is loose milk a health hazard? Report of the Milk Commission, Department of Health, New York City, November 1931.

TABLE 3. PRICES OF GRADE B MILK ON RETAIL ROUTES AND AT RETAIL FOOD STORES IN NEW YORK CITY

Year	Doorstep-delivery price	Store price	Difference
	Cents per quart		
1925–29	15.4	10.7*	4.7
1930	15.8	10.7*	5.1
1931	14.7	10.4*	4.3
1932	11.9	8.9*	3.0
1933	11.1	9.1†	2.0
1934	12.6	10.5†	2.1
1935	13.0	11.0†	2.0
1936	13.1	11.0†	2.1
1937	12.6	9.7†	2.9
1938	13.1	9.4†	3.7
1939	13.4	10.1†	3.3

*Loose milk.
†"Unadvertised" brands.

Nearly two-thirds of the sweet cream sold in the city is heavy cream, containing about 40 per cent butterfat. Less than one-tenth is medium cream, and the remainder is light cream, containing about 20 per cent butterfat. Nearly all the sweet cream for home consumption is of the "heavy" grade. Most of the light cream and all of the medium cream is sold to hotels and restaurants.

TABLE 4. APPROXIMATE DISTRIBUTION OF SALES OF SWEET CREAM IN NEW YORK CITY, BY TRADE OUTLET AND GRADE, DECEMBER 1938*

Trade outlet	Grade of cream			
	Light	Medium	Heavy	Total
	Per cent			
Family trade, retail routes	1.4	...	6.4	7.8
Stores	2.3	...	55.2	57.5
Restaurants, hotels, etc.	23.5	9.5	1.7	34.7
Total	27.2	9.5	63.3	100.0

*Based on reports of milk dealers to the New York City Department of Health, and supplementary data obtained direct from dealers.

Dealers' sales of heavy cream did not decline so rapidly as did total receipts of cream in the market during the early years of the period studied (figure 6). Also, the sales recorded did not reach so low a level as did total cream receipts, nor have they shown so much recovery in the past few years. Sales of heavy cream, as represented in this index, were mainly for home consumption, while, as previously stated, total cream receipts include cream used in the manufacture of ice cream and that used by restaurants, hotels, and the like. The sharp decline in receipts of cream in November 1937 was due to a cream shortage in the milkshed, with the result that certain demands in the market were not supplied.

Dealers' sales of cream to retail food stores fell off sharply during 1933 (figure 7). From January 1934 through 1937, there was little variation in the sales of cream either on the retail routes or at stores.

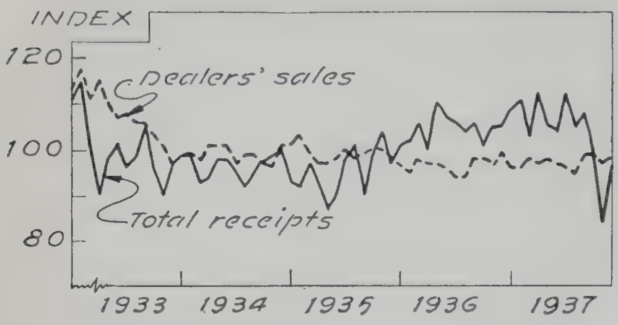

FIGURE 6. DEALERS' SALES OF HEAVY CREAM, AND TOTAL RECEIPTS OF CREAM IN THE NEW YORK MARKET (1933–37 = 100)

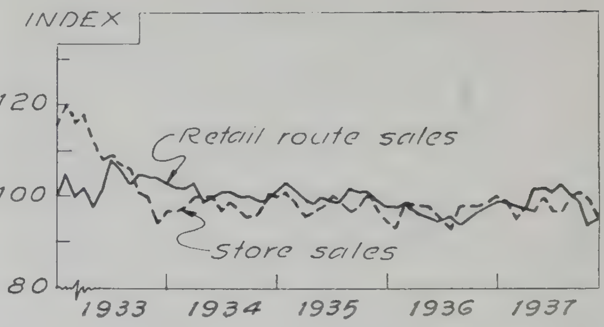

FIGURE 7. DEALERS' SALES OF HEAVY CREAM TO FAMILY TRADE AND TO RETAIL FOOD STORES IN THE NEW YORK MARKET (1933–37 = 100)

SEASONAL VARIATION IN SALES[4]

Seasonal variation in sales of milk and cream in the New York market are caused chiefly by two factors: the movement of large numbers of people out of the metropolitan area for vacations, and the major temperature changes of the passing seasons. These factors act in opposition, since both the per capita consumption of milk and the number of persons going away on vacations increase as midsummer approaches. The sales of different products and of the same products in different types of packages and through different trade outlets are affected in varying degrees by the seasons, depending on the relative quantities used by different groups of consumers.

In the following discussion, comparisons are made with the results of a similar study covering the period 1920-24.[5] Two factors have resulted in a marked change in the seasonal-variation curves; decreased sales caused by the curtailed purchasing power of a large proportion of con-

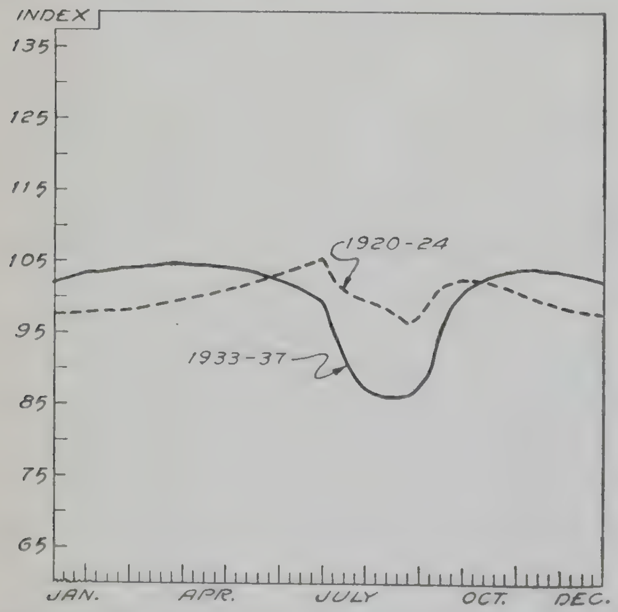

FIGURE 8. SEASONAL VARIATION IN DEALERS' RETAIL SALES OF QUARTS OF GRADE B MILK

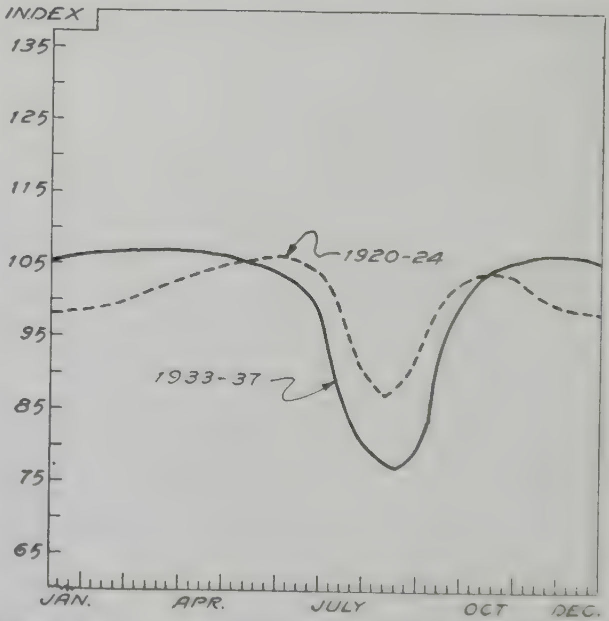

FIGURE 9. SEASONAL VARIATION IN DEALERS' RETAIL SALES OF QUARTS OF GRADE A MILK

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[4] Seasonal variation was calculated as follows: sales during each week were expressed as a percentage of a 52-weeks moving average centered on the 26th week. The percentages for corresponding weeks of the several years were then averaged and plotted. A smooth curve was fitted to these data and the seasonal index read from the smooth curve.

[5] The demand side of the New York milk market. By H. A. Ross. Cornell Univ. Agr. Exp. Sta. Bul. 459. 1927.

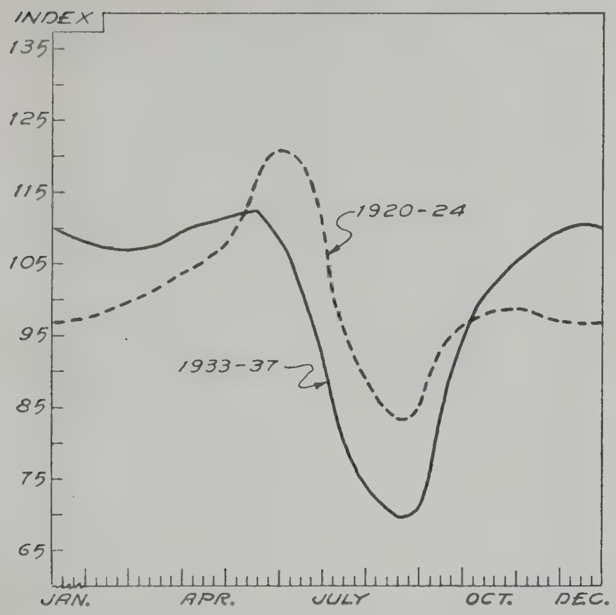

Figure 10. seasonal variation in dealers' retail sales of heavy cream

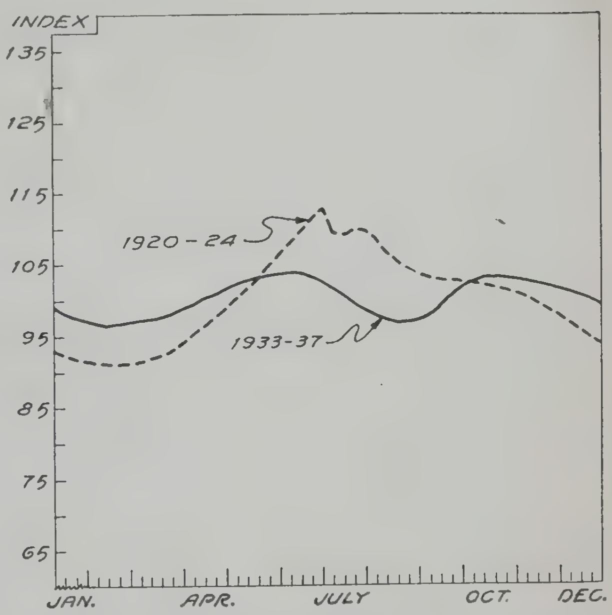

Figure 11. seasonal variation in dealers' retail sales of pints of grade b milk

sumers, and the shift of patronage from retail routes to retail food stores by a large number of families, particularly those in the low-income group.

Seasonal variations in dealers' retail sales of quarts of Grade B milk, Grade A milk, heavy cream, and pints of Grade B milk are shown in figures 8 to 11. In each case it is noticeable that sales during the summer months show a greater decline in the later period; also that sales begin to fall off earlier in the summer and do not return to the normal level until later in the fall. Probably the families concerned are a more select group, and a smaller proportion of them lack the incomes that are necessary for vacations outside the city. Another probable reason is that the vacation habit is more general than it was at the time the earlier study was made.

Seasonal variation in dealers' sales of quarts of Grade B milk, Grade A milk, and heavy cream to retail food stores are shown in figures 12

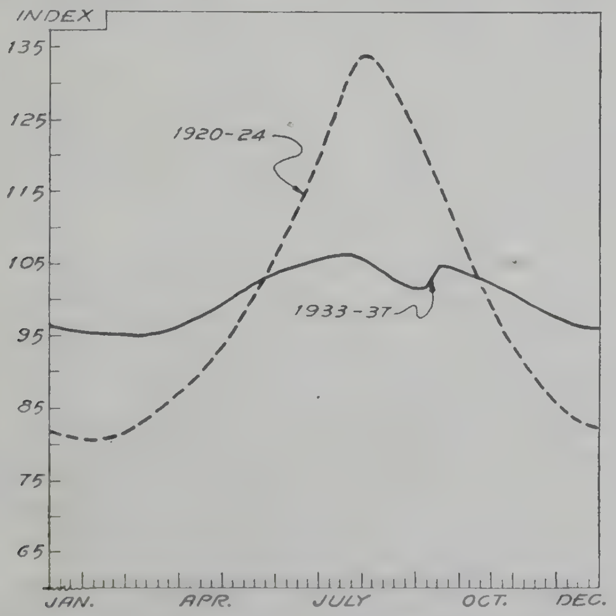

Figure 12. seasonal variation in dealers' sales of quarts of grade b milk to retail food stores

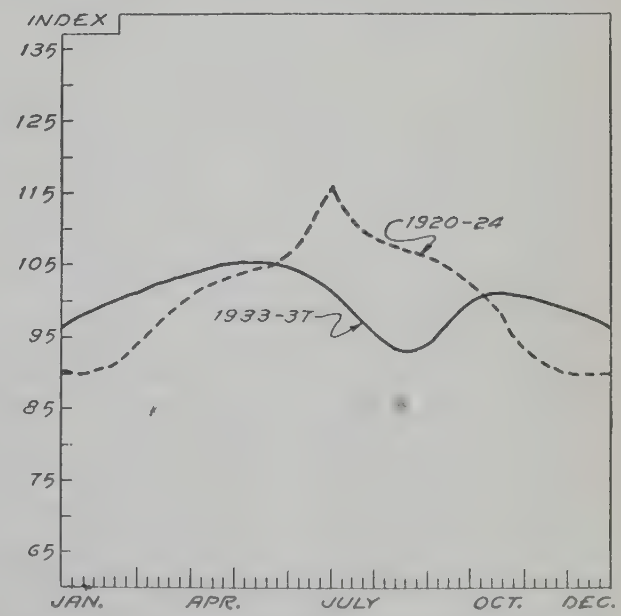

Figure 13. seasonal variation in dealers' sales of quarts of grade a milk to retail food stores

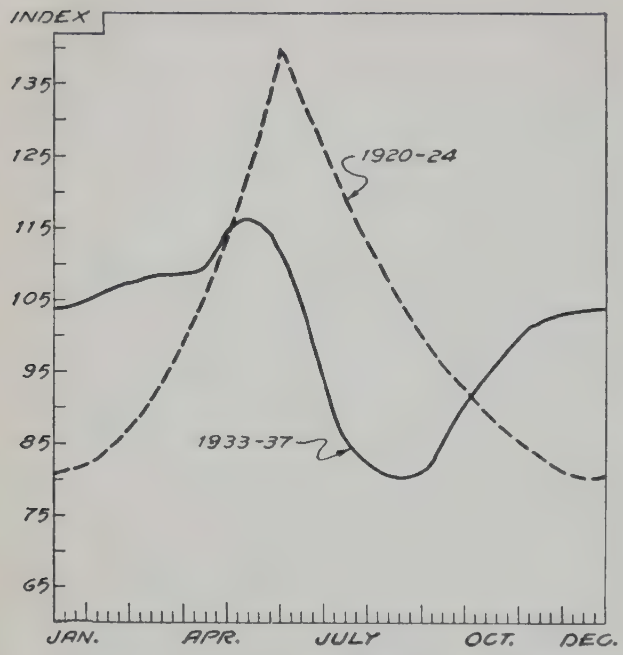

FIGURE 14. SEASONAL VARIATION IN DEALERS' SALES OF HEAVY CREAM TO RETAIL FOOD STORES

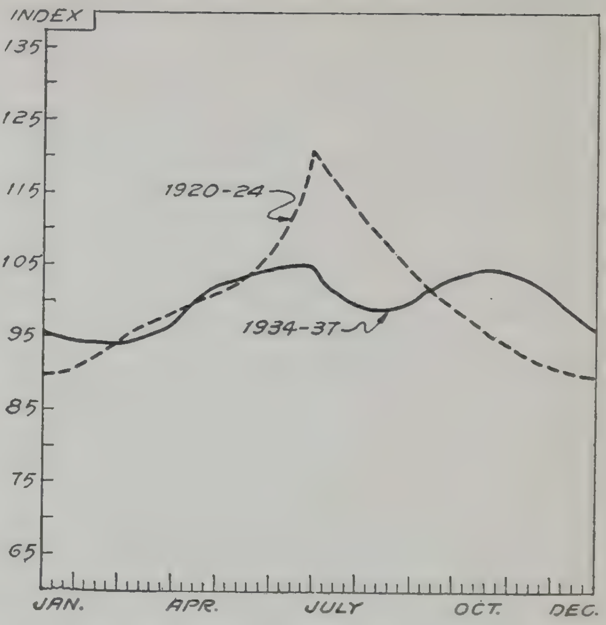

FIGURE 15. SEASONAL VARIATION IN DEALERS' SALES OF GRADE B BULK MILK

to 14. For each product it is noticeable that vacation movements appear to have had a significant effect on sales during the later period, although in the previous study there was little evidence of this. Seasonal-variation curves for dealers' sales to stores in the recent period are similar to the curves for retail-route sales in the earlier period.

Seasonal variation in dealers' sales of Grade B bulk milk for the two periods is shown in figure 15. Bulk-milk sales in the earlier period were made largely to retail food stores for resale to family trade. This was discontinued in 1933. Bulk-milk sales since that time have been made to restaurants, hotels, hospitals, and the like. The serving of bulk milk in restaurants and hotels was discontinued April 1, 1938, except where dispensing devices, approved by the Department of Health, were installed. Because of this the quantity of bulk milk sold by dealers was greatly reduced, but is now increasing gradually.

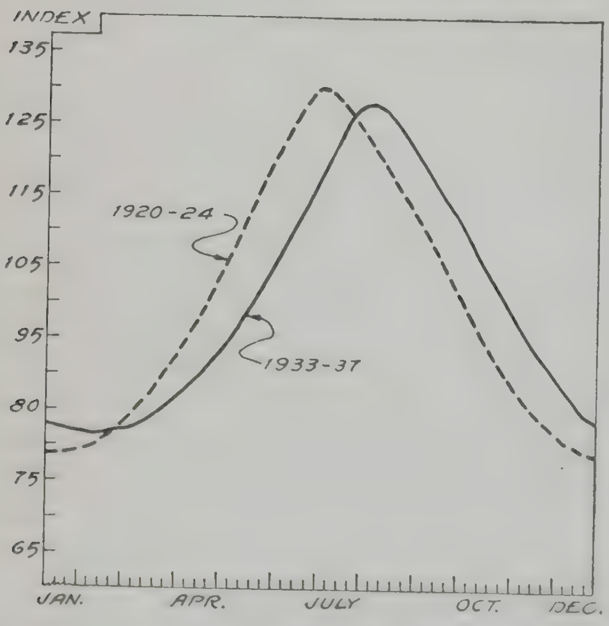

FIGURE 16. SEASONAL VARIATION IN DEALERS' WHOLESALE SALES OF PINTS OF GRADE B MILK

There has been little change in the seasonal variation in dealers' wholesale sales of pints of Grade B milk and dealers' retail and wholesale sales of buttermilk (figures 16 to 18). These products are purchased mainly by adult workers for lunch. Such sales are materially affected by changes in temperature, since these consumers shift from hot beverages to cooler drinks in hot weather.

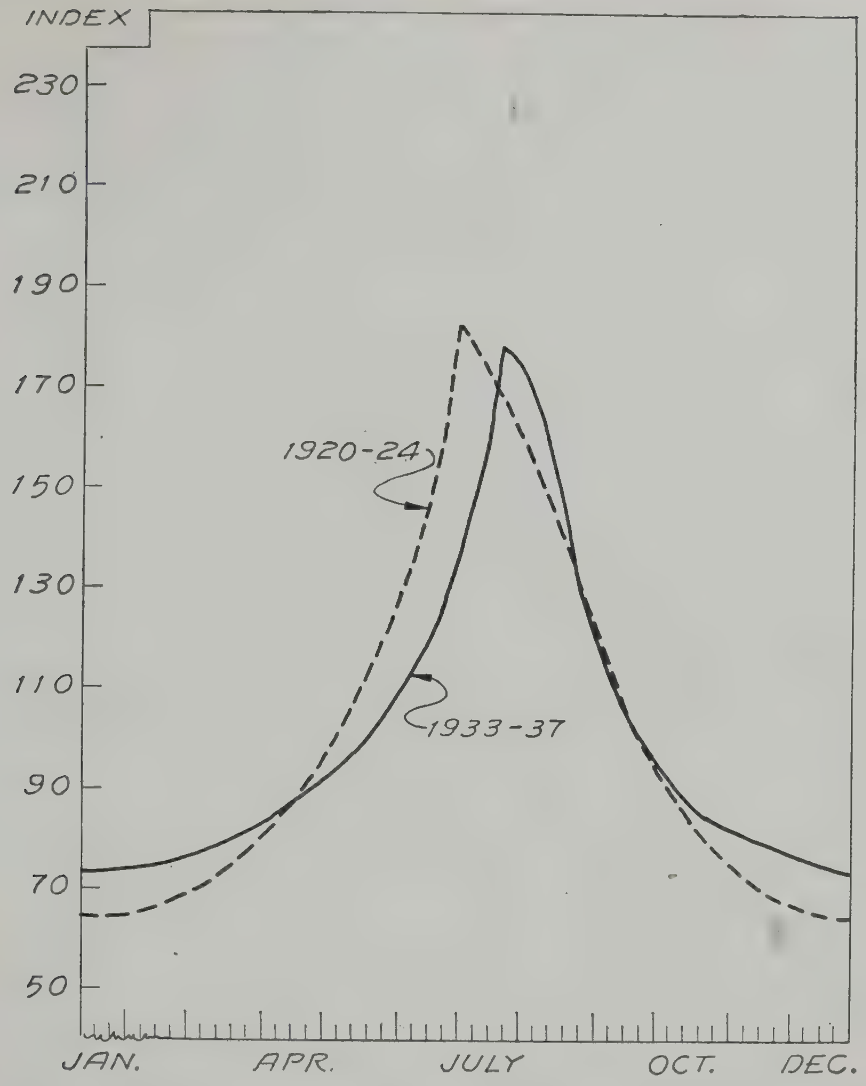

Figure 17. seasonal variation in dealers' retail sales of buttermilk

DAY-OF-THE-WEEK VARIATIONS IN SALES[6]

Because many retail food stores are closed all or part of Sunday, milk and cream sales on Sunday are low in relation to weekday sales, but are high on Saturday and Monday (table 5).

TABLE 5. Day-of-the-Week Variation in Dealers' Sales of Milk and Cream to Retail Food Stores in 1937

Item	Day of the week							
	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Average
	Per cent of average for all days of the week							
Grade A milk	63.9	104.7	106.8	100.0	101.0	108.0	115.6	100.0
Grade B milk in glass bottles	77.7	106.1	102.2	101.5	103.1	102.1	107.3	100.0
Grade B milk in paper containers	75.4	101.7	100.3	103.3	104.3	101.9	113.1	100.0
Heavy cream, bottled	36.3	116.4	103.0	96.3	98.2	107.2	142.6	100.0
Heavy cream, bulk	68.0	106.3	100.2	98.1	97.2	107.1	123.1	100.0

Day-of-the-week variation in store sales of the several products is shown graphically in figures 19 to 23. The differences are due largely to the variation in quantities sold in different types of stores and in areas of different nationality and income. For example, Grade B milk in paper containers and bottled heavy cream were sold more largely by chain stores and in areas of relatively high family incomes; on the other hand, Grade B milk in glass bottles and bulk heavy cream were sold more largely by independent stores and in the low-income areas.

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[6] This discussion pertains only to dealers' sales to retail food stores. For day-of-the-week variations in sales on retail routes, see *The Demand Side of the New York Milk Market*, p. 39-44, by H. A. Ross. (Cornell Univ. Agr. Exp. Sta., Bul. 459, 1927).

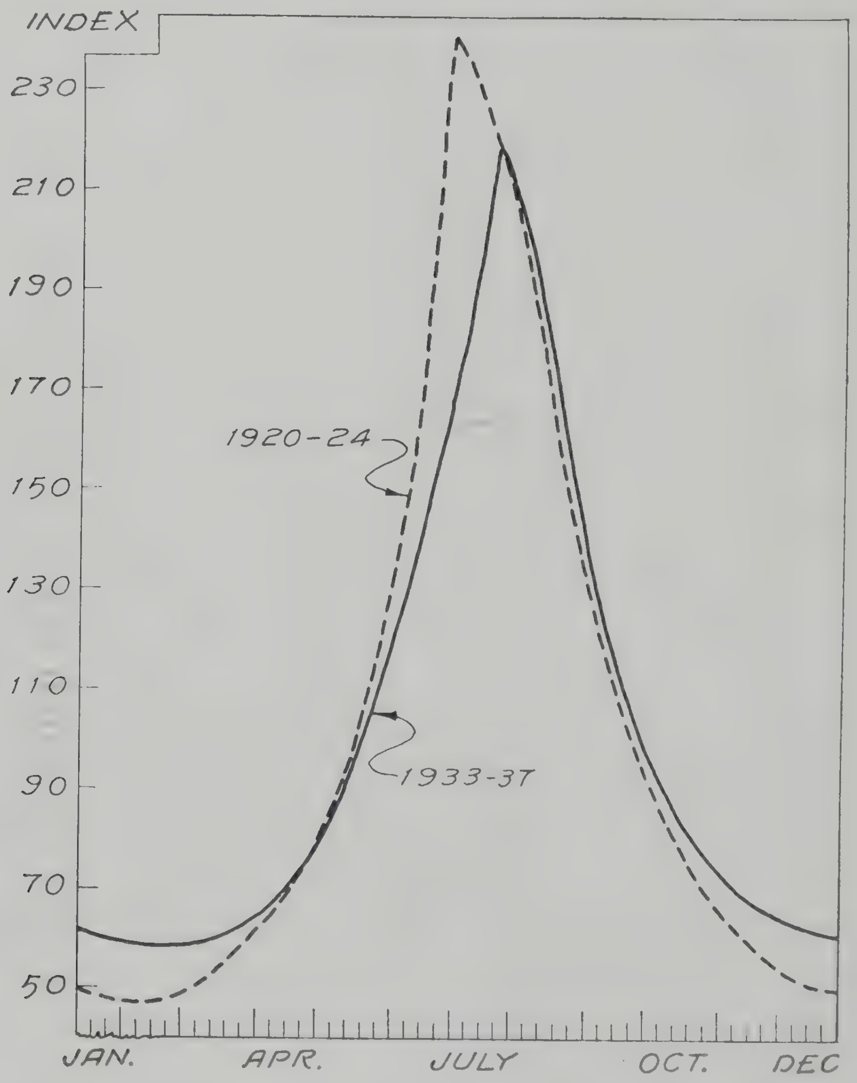

FIGURE 18. SEASONAL VARIATION IN DEALERS' WHOLESALE SALES OF BUTTERMILK

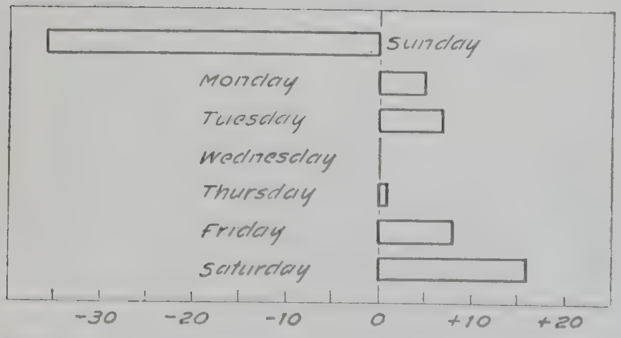

FIGURE 19. DAY-OF-THE-WEEK VARIATION IN DEALERS' SALES OF GRADE A MILK TO RETAIL FOOD STORES

Sales for each day of the week are expressed as percentage above or below average daily sales for the week

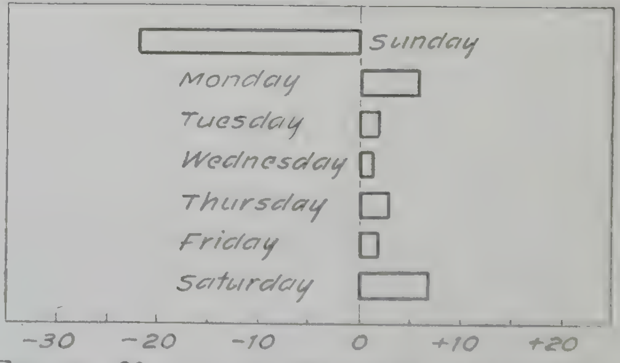

FIGURE 20. DAY-OF-THE-WEEK VARIATION IN DEALERS' SALES OF GRADE B MILK IN GLASS BOTTLES TO RETAIL FOOD STORES

Sales for each day of the week are expressed as percentage above or below average daily sales for the week

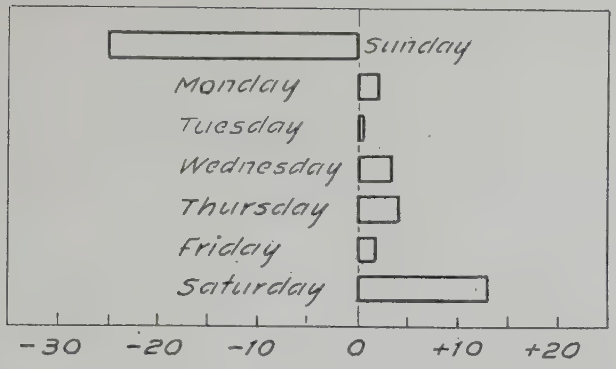

FIGURE 21. DAY-OF-THE-WEEK VARIATION IN DEALERS' SALES OF GRADE B MILK IN PAPER CONTAINERS TO RETAIL FOOD STORES

Sales for each day of the week are expressed as percentage above or below average daily sales for the week

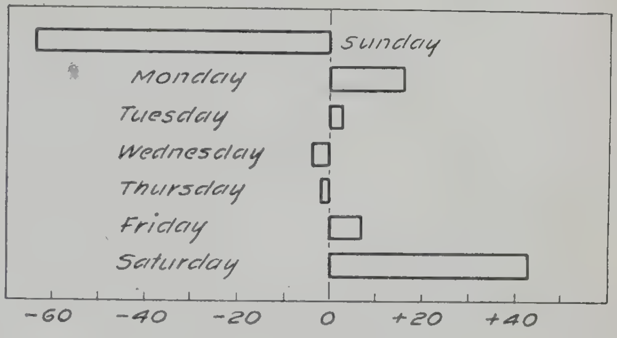

FIGURE 22. DAY-OF-THE-WEEK VARIATION IN DEALERS' SALES OF HEAVY CREAM IN HALF-PINT BOTTLES AND CONTAINERS TO RETAIL FOOD STORES

Sales for each day of the week are expressed as percentage above or below average daily sales for the week

A survey of retail food stores, made in June 1938, revealed that Sunday closing is more general among the chain stores and in areas of medium and high family incomes (tables 6 and 7).[7]

TABLE 6. PROPORTION OF THE DIFFERENT TYPES OF STORES IN NEW YORK CITY THAT WERE KEPT OPEN ON SUNDAY, JUNE 1938

Type of store	Proportion of the stores—			
	Closed all day Sunday	Open part of day Sunday	Open all day Sunday	Total
	Per cent			
Independent grocery store	33.7	49.7	16.6	100.0
Chain grocery store	99.0	0.6	0.4	100.0
Independent dairy store	48.1	42.5	9.4	100.0
Chain dairy store	100.0	....	....	100.0
Dairy stand	57.1	40.3	2.6	100.0
Delicatessen	6.0	62.9	31.1	100.0
Retail bakery shop	7.2	48.2	44.6	100.0
Other*	41.9	48.4	9.7	100.0
All stores	45.9	39.4	14.7	100.0

*Restaurants, soda fountains, etc., where milk is sold to be taken away; also includes a few grocery stands in the public markets.

TABLE 7. PROPORTION OF RETAIL FOOD STORES THAT WERE KEPT OPEN ON SUNDAY IN DIFFERENT INCOME AREAS OF NEW YORK CITY, JUNE 1938

Income areas	Proportion of the stores—			
	Closed all day Sunday	Open part of day Sunday	Open all day Sunday	Total
	Per cent			
Low	34.5	45.6	19.9	100.0
Medium	52.2	37.5	10.3	100.0
High	63.0	22.2	14.8	100.0
All areas	45.9	39.4	14.7	100.0

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[7] Sales of milk by retail food stores in the New York market, June 1938. By Charles Blanford. Cornell Univ., Dept. Agr. Econ. A. E. 237 [mimeographed] 1939.

HOLIDAY VARIATIONS IN SALES[8]

Variations in sales of milk and cream due to holidays are of three types: decreased sales of some products on holidays which permit a portion of the population to leave town; increased sales of some products on holidays such as Thanksgiving and Christmas; increased or decreased sales on various religious holidays.

The variations in dealers' sales of Grade B milk and heavy cream to retail food stores due to holidays in 1937 are shown in tables 8 and 9.

TABLE 8. EFFECT OF HOLIDAYS ON DEALERS' SALES OF GRADE B MILK TO RETAIL FOOD STORES, 1937*

Holiday	Day of week on which holiday occurred	Second day previous	Previous day	Holiday	Following day	Second day following
				Per cent		
New Year's Day	Friday	99.7	103.2	81.8	98.5	99.3
Lincoln's Birthday	Tuesday	99.3	100.7	95.9	98.4	101.4
Washington's Birthday	Friday	97.8	101.0	91.6	99.1	99.2
Purim	Thursday	99.1	99.2	98.8	96.7	95.6
Passover	....	97.6	102.5	85.8†	101.8	101.3
Easter	Sunday	‡	94.6	87.9	102.7	101.9
Memorial Day	Sunday (observed on Monday)	107.1	98.7	95.7	82.8	106.6
Independence Day	Sunday (observed on Monday)	92.3	87.9	86.3	71.3	97.0
Labor Day	Monday	106.7	137.0	52.8	81.7	104.6
Yom Kippur	Wednesday	103.3	103.6	65.3	93.2	92.1
Thanksgiving	Thursday	104.0	106.4	85.2	93.4	95.7
Christmas	Saturday	100.0	103.4	75.9	88.4	92.2

*Sales on day of the holiday are expressed as a percentage of the average daily sales for the same day of the week during the month in which the holiday occurred.
†Average for the period of Passover.
‡Conflicts with day before beginning of Passover.

TABLE 9. EFFECT OF HOLIDAYS ON DEALERS' SALES OF HEAVY CREAM TO RETAIL FOOD STORES, 1937*

Holiday	Day of week on which holiday occurred	Second day previous	Previous day	Holiday	Following day	Second day following
				Per cent		
New Year's Day	Friday	102.0	117.1	70.4	97.9	80.4
Lincoln's Birthday	Tuesday	93.9	106.8	110.0	97.1	112.5
Washington's Birthday	Friday	96.9	109.5	89.2	102.0	94.8
Purim	Thursday	102.0	94.8	105.2	105.0	90.6
Passover	....	96.3	108.7	89.0†	102.3	99.4
Easter	Sunday	‡	91.1	85.5	95.6	105.4
Memorial Day	Sunday (observed on Monday)	104.0	91.4	86.1	51.2	118.9
Independence Day	Sunday (observed on Monday)	100.9	110.9	94.6	70.8	116.0
Labor Day	Monday	84.7	123.8	53.1	80.1	107.9
Yom Kippur	Wednesday	105.2	80.2	77.4	92.8	82.1
Thanksgiving	Thursday	102.8	130.1	91.3	105.0	99.3
Christmas	Saturday	98.8	111.4	63.5	85.3	88.4

*Sales on day of the holiday are expressed as a percentage of the average daily sales for the same day of the week during the month in which the holiday occurred.
†Average for the period of Passover.
‡Conflicts with day before beginning of Passover.

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[8] Variations in retail-route sales due to holidays are discussed in *The Demand Side of the New York Milk Market*, p. 44-47, by H. A. Ross. (Cornell Univ. Agr. Exp. Sta., Bul. 459, 1937).

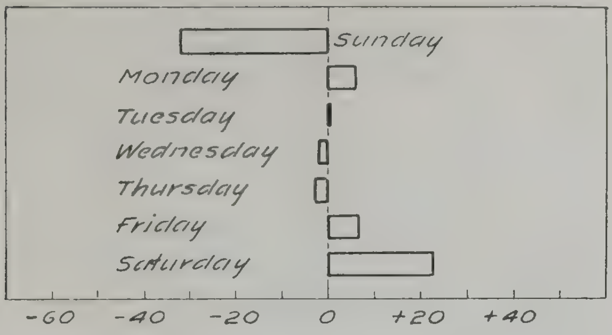

FIGURE 23. DAY-OF-THE-WEEK VARIATION IN DEALERS' SALES OF HEAVY CREAM IN BULK TO RETAIL FOOD STORES

Sales for each day of the week are expressed as percentage above or below average daily sales for the week

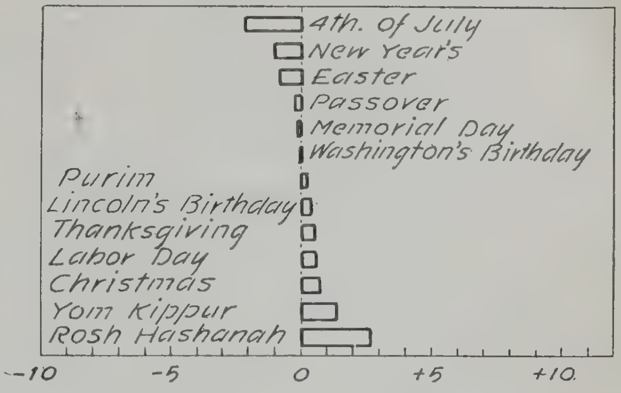

FIGURE 24. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF QUARTS OF GRADE B MILK TO FAMILY TRADE

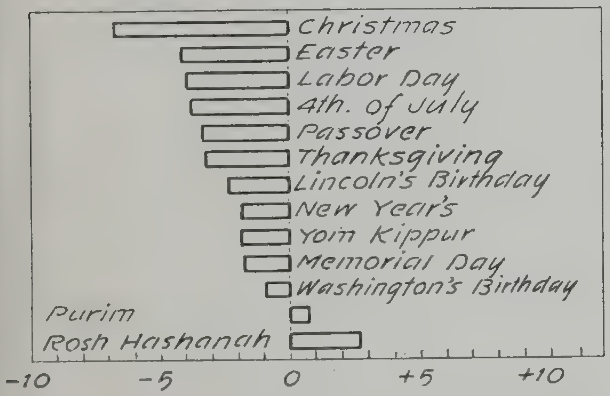

FIGURE 25. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF QUARTS OF GRADE B MILK TO RETAIL FOOD STORES

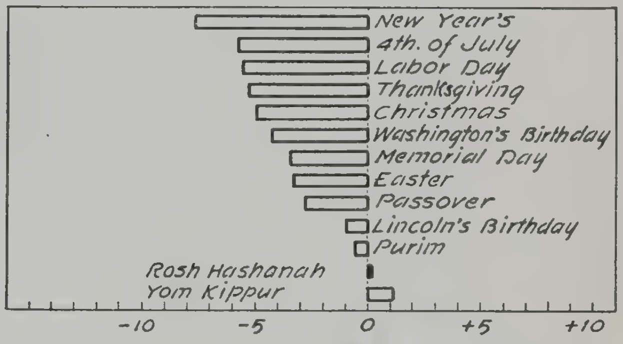

FIGURE 26. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF PINTS OF GRADE B MILK TO FAMILY TRADE

Milk sales at stores were low on all holidays, but were particularly low on holidays, such as Memorial Day, the Fourth of July, and Labor Day, which occurred on Saturday or Monday, thus permitting a large number of people to be out of town for a weekend. In general, cream sales were affected more by holidays than were the sales of milk.

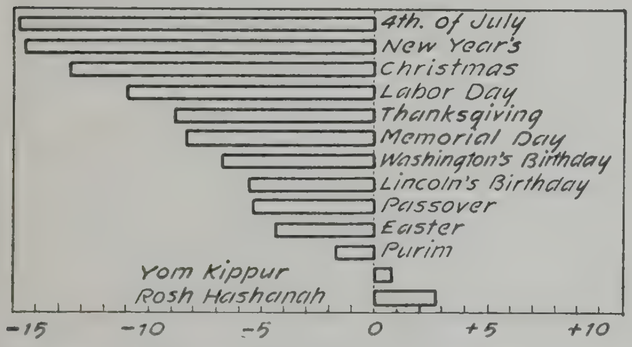

FIGURE 27. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF PINTS OF GRADE B MILK TO RETAIL FOOD STORES

The effects of holidays on sales of the various products during the week when the holiday occurred are shown in figures 24 to 33.[9] These data give a more nearly accurate measure of the effect of holidays on sales because they are for five years, as contrasted with only one year for the daily sales.

Dealers' retail sales of quarts of Grade B milk are only slightly affected by holidays. The greatest decrease in sales was 2.2 per cent during the week of July 4. The greatest increase was 2.7 per cent during the week of Rosh Hashanah, the Jewish New Year.

With two exceptions, dealers' sales of quarts of Grade B milk to retail food stores decreased in weeks in which holidays occurred. The greatest

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[9] Sales during the weeks in which holidays occurred were expressed as percentage change from the average weekly sales during the previous three weeks.

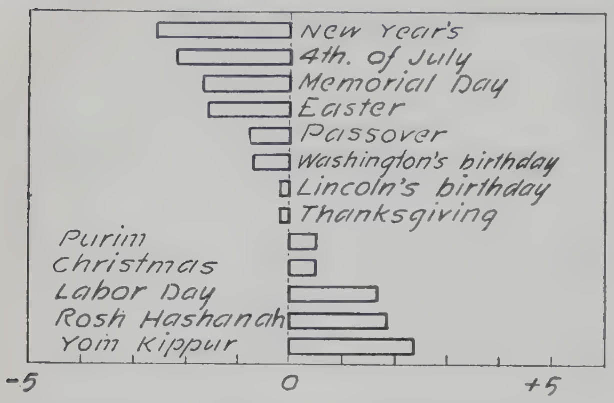

FIGURE 28. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF GRADE A MILK TO FAMILY TRADE

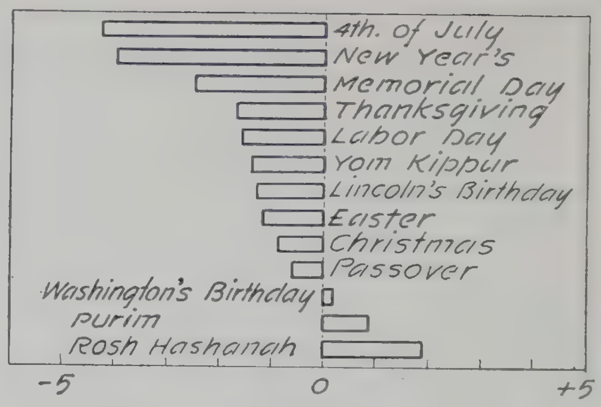

FIGURE 29. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF GRADE A MILK TO RETAIL FOOD STORES

decrease occurred during Christmas week. The only weeks in which there was an increase were the weeks of Purim and Rosh Hashanah.

Sales of pints of Grade B milk, both to family trade[10] and to retail food stores, were smaller in all weeks in which holidays occurred, except for Yom Kippur and Rosh Hashanah. The decrease in store sales was nearly twice as great in each case as the decrease in retail sales. As pointed out earlier, pints are purchased mainly by adults for luncheon. Since many of these consumers do not work on holidays, sales of this product decrease materially.

The effect of holidays on Grade A milk sales to family trade and to retail food stores was slight. Grade A milk is consumed primarily by children, whose consumption habits vary little from day to day.

Dealers' retail sales of heavy cream were greater in all but four weeks in which holidays occurred. Sales of cream during Thankgiving week were nearly 20 per cent greater than normal cream sales.

Dealers' sales of heavy cream to retail food stores were less affected by holidays. There was a decrease in store sales of cream during seven of the thirteen weeks studied. The difference in effect of holidays on retail and store sales of heavy cream is explained by the differences in income status of consumers purchasing from the two sources. The families taking cream from retail routes belong mostly to the high-income group, while more of those buying at stores have only medium or low incomes.

Both retail and wholesale sales of buttermilk decreased in nearly all

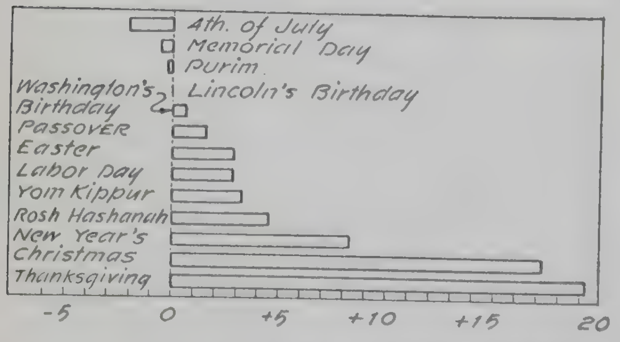

FIGURE 30. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF HEAVY CREAM TO FAMILY TRADE

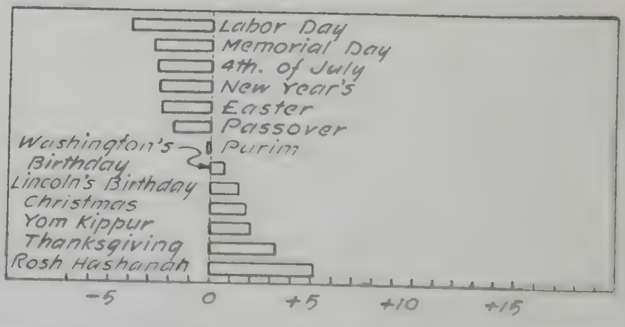

FIGURE 31. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF HEAVY CREAM TO RETAIL FOOD STORES

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[10] Sales to family trade include sales in offices, on construction jobs, and the like.

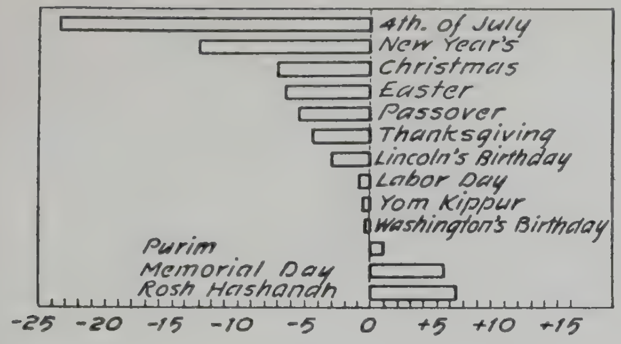

FIGURE 32. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF BUTTERMILK TO FAMILY TRADE

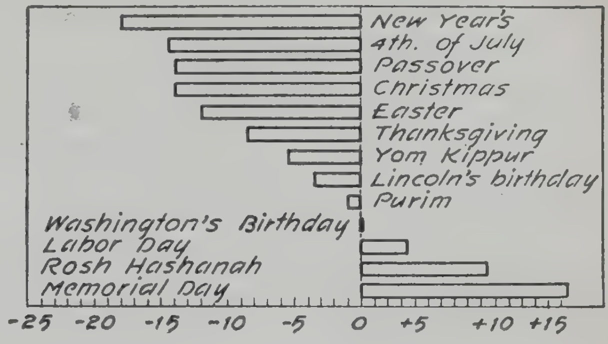

FIGURE 33. EFFECT OF HOLIDAYS ON DEALERS' WEEKLY SALES OF BUTTERMILK TO STORES AND RESTAURANTS

weeks in which holidays occurred.[11] As pointed out earlier, buttermilk is consumed primarily by adults for lunch. Since many of these consumers do not work on holidays, sales of buttermilk decrease in weeks in which holidays occur.

VARIATIONS IN SALES DUE TO PRICE CHANGES

The effect of price changes on the sales of milk is very difficult to measure statistically. The available data on weekly sales pertain only to the larger milk distributors. Their total sales are heavily weighted by retail-route sales to consumers with relatively high incomes and by sales to chain food stores which also are patronized by families whose incomes are well above the average. Also, it is difficult to eliminate changes in sales which represent shifts in business among dealers. During the period studied, as pointed out earlier, there was a considerable shift of milk sales from retail routes to retail food stores. It is difficult to establish continuous and accurate series of data for either sales or prices for milk at retail food stores.

The method of analysis that is used here to determine variations in sales due to price changes shows primarily the short-time effects. The longer-time effects are even more difficult to measure.

From April 1933 to April 1937, the retail prices of milk in New York City were set by the Division of Milk Control. In April 1937, state price-fixing in New York was discontinued. Prices in the New Jersey section of the market were set by the New Jersey Milk Control Board throughout the entire period studied.

During the period covered by this study (1933-37), the price of milk in New York City was raised 1 cent per quart, or about 7 to 10 per cent, seven times, and was lowered a like amount three times. In New Jersey, the price was increased 1 cent per quart five times, and lowered a like amount twice.

Although the data are too variable to justify definite conclusions, it is apparent that a 1-cent increase in the price of milk caused only a very slight reduction in sales, considerably less than 1 per cent. Likewise a 1-cent reduction in price brought less than 2 per cent increase in sales during the first week. No significant effects can be traced beyond the second week (figures 34 and 35). Consumer response to price changes of 1 cent per quart in the price of milk apparently was no greater during this period of relatively low consumer purchasing power than during

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[11] Retail sales include sales in offices, on construction jobs, and the like.

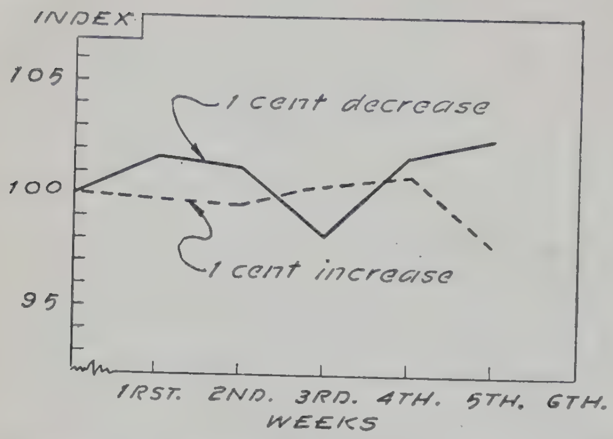

FIGURE 34. EFFECT OF PRICE CHANGES OF ONE CENT PER QUART ON DEALERS' TOTAL SALES OF GRADE B MILK IN NEW YORK CITY

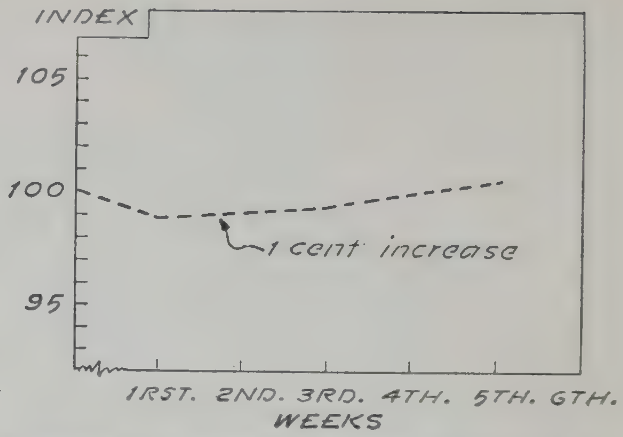

FIGURE 35. EFFECT OF PRICE CHANGES OF ONE CENT PER QUART ON DEALERS' TOTAL SALES OF GRADE B MILK IN NEW JERSEY

the period studied by Ross, which was a period of relatively high consumer purchasing power.[12]

Cream prices were raised 1 cent per half pint, or about 5 per cent, seven times in New York City during the period studied, and were reduced a like amount twice.

The 1-cent increases in the price of cream appear to have had a significant effect on the sales of cream, but the reduction was only about 2 per cent (figures 36 and 37).

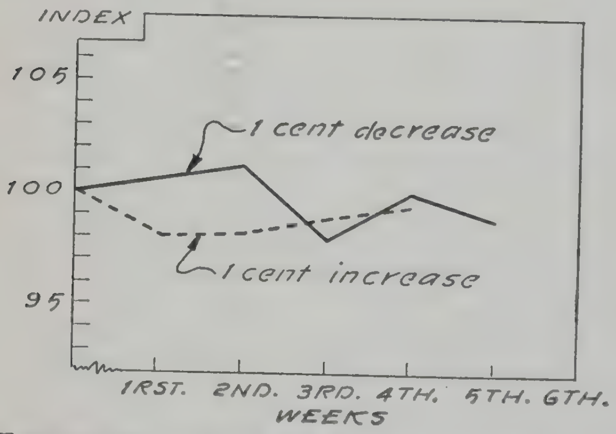

FIGURE 36. EFFECT OF PRICE CHANGES OF ONE CENT PER HALF PINT ON DEALERS' TOTAL SALES OF HEAVY CREAM IN NEW YORK CITY

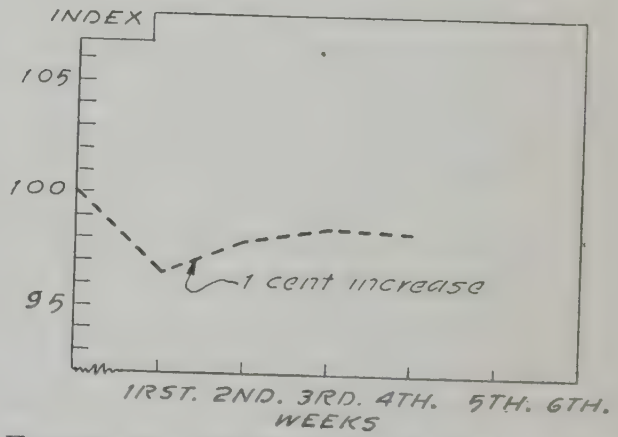

FIGURE 37. EFFECT OF PRICE CHANGES OF ONE CENT PER HALF PINT ON DEALERS' TOTAL SALES OF HEAVY CREAM IN NEW JERSEY

There were five increases of 2 cents in the price of cream in New Jersey, and this amount of increase apparently caused a marked reduction in sales (figure 38). Likewise, decreases of 2 cents in the price of cream resulted in somewhat larger sales.

Price increases of 3 cents per half pint in both New York City and New Jersey resulted in very marked decreases in sales of heavy cream (figures 39 and 40).

VARIATION IN SALES DUE TO CHANGES IN BUSINESS CONDITIONS

One of the most important factors affecting sales of milk and cream generally over a period of time is the purchasing power of consumers.

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[12] Ross, H. A. The demand side of the New York milk market. Cornell Univ. Agr. Exp. Sta. Bul. 459. 1927.

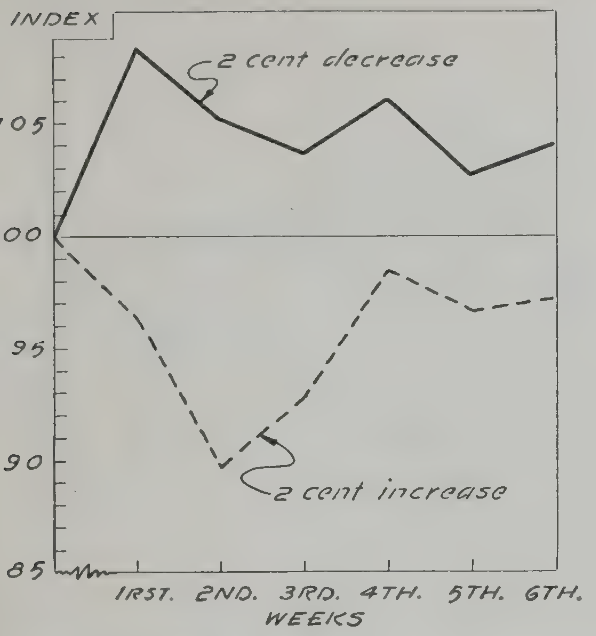

Figure 38. effect of price changes of two cents per half pint on dealers' total sales of heavy cream in new jersey

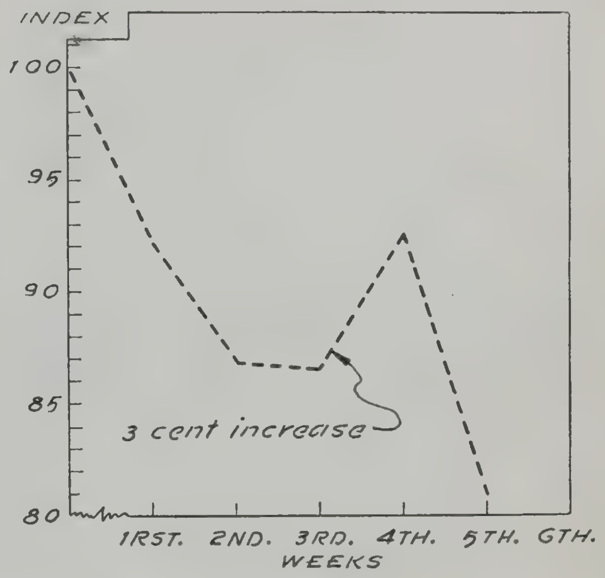

Figure 39. effect of price changes of three cents per half pint on dealers' total sales of heavy cream in new york city

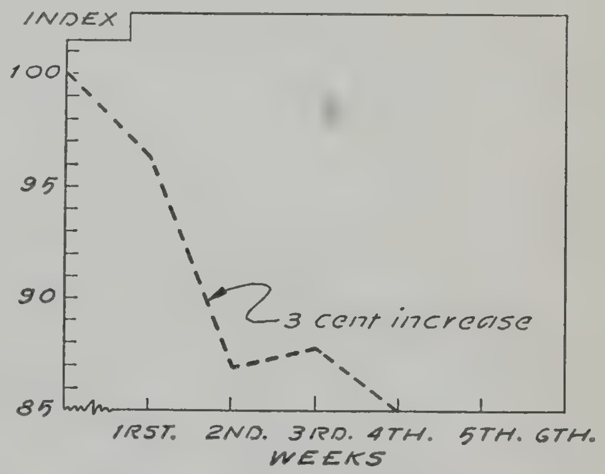

Figure 40. effect of price changes of three cents per half pint on dealers' total sales of heavy cream in new jersey

This is true to an even greater extent during a depression than during a period of prosperity.

Changes in milk sales appear to follow about ten months after changes in business activity, as measured by the *New York Times Index,* but the relationship is not very close (figure 41). This index reflects business conditions throughout the country rather than those in New York City particularly. The Federal Reserve Bank of New York publishes, in its *Monthly Review of Credit and Business Conditions,* an indication of department-store sales in New York and Brooklyn. Changes in milk receipts at the New York market follow this index of department-store sales with a lag of five months (figure 42).[13] Although there is a general relationship between milk receipts and business activity over a period of time, milk receipts do not have the violent changes that are characteristic of business activity as measured by the *New York Times Index* and by the index of department-store sales.

Receipts of cream at the market appear to follow New York and Brooklyn department-store sales with a lag of ten months (figure 43). In 1930, and again in 1937, an increase in department-store sales was not followed by increased cream receipts. In 1932, a drop in department-store sales was not followed by a decrease in cream receipts.

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[13] Department-store sales are a total-value figure, as compared with a physical-volume figure for milk receipts, and thus are affected by variations in prices as well as by variations in volume.

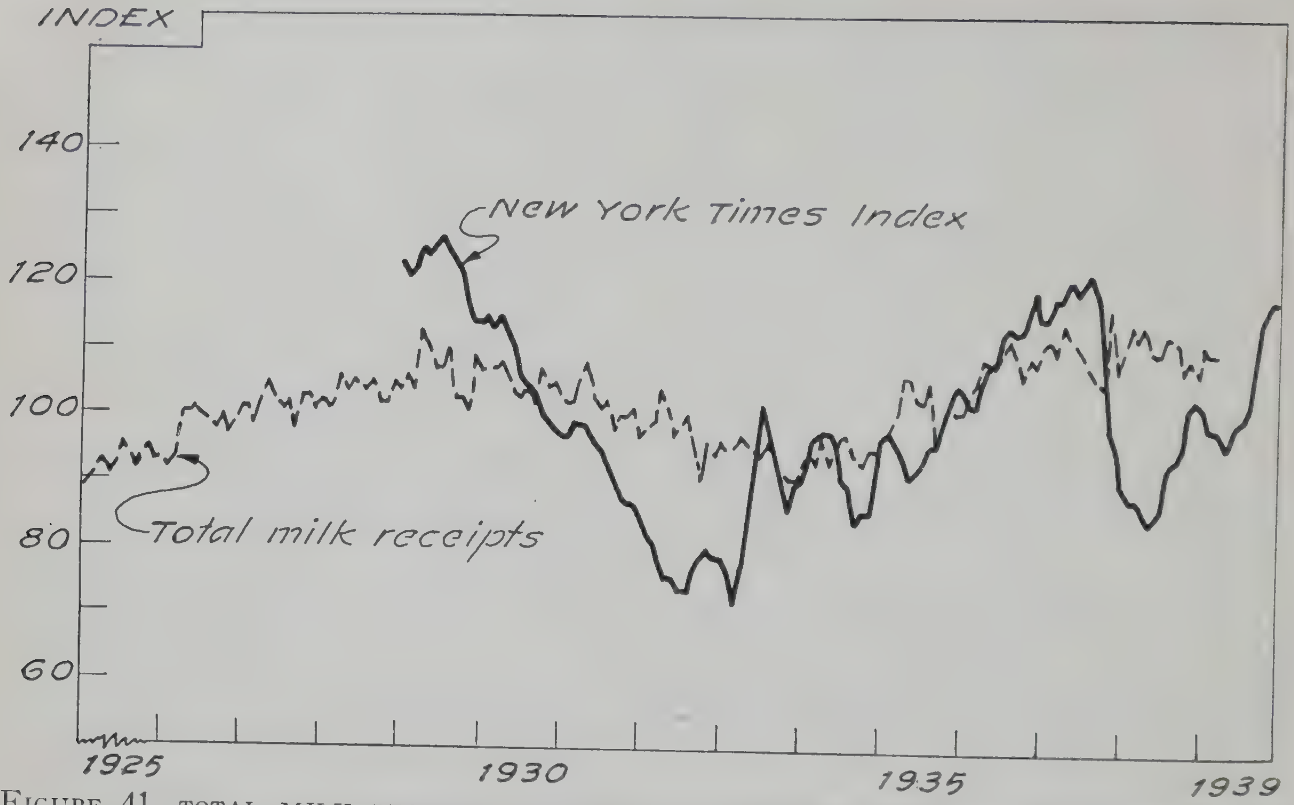

FIGURE 41. TOTAL MILK RECEIPTS AT THE NEW YORK MARKET, AND THE NEW YORK TIMES INDEX OF BUSINESS ACTIVITY TEN MONTHS EARLIER (1933–37 = 100)

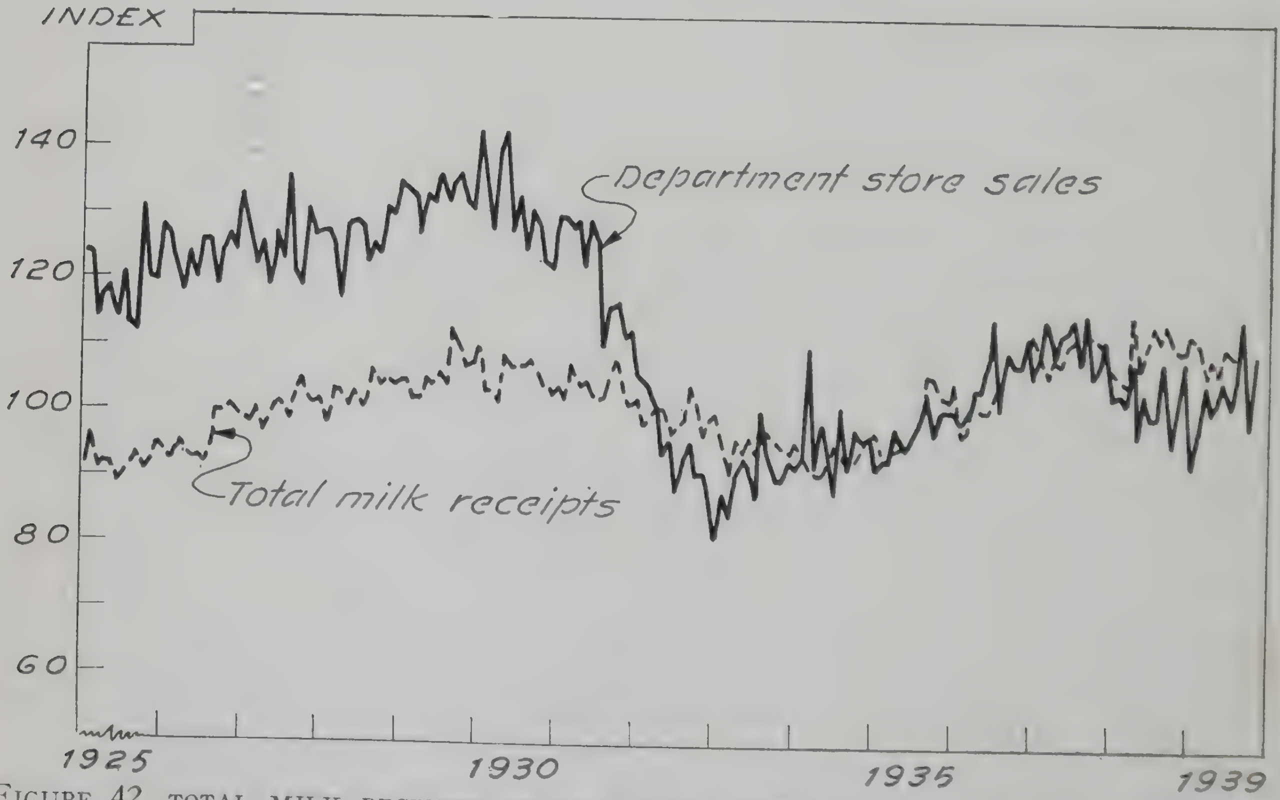

FIGURE 42. TOTAL MILK RECEIPTS AT THE NEW YORK MARKET, AND NEW YORK AND BROOKLYN DEPARTMENT-STORE SALES FIVE MONTHS EARLIER (1933–37 = 100)

SUMMARY AND CONCLUSIONS

Receipts of milk at the New York market, which are a good indication of total milk consumption, increased steadily until 1930. After 1930 there was a sharp falling off in receipts for about four years. The total for 1934 was 12 per cent below that for 1930. Milk receipts again turned upward in 1935. There were marked increases in 1936 and 1937. The receipts during 1939 were greater by 2 or 3 per cent than those of 1930.

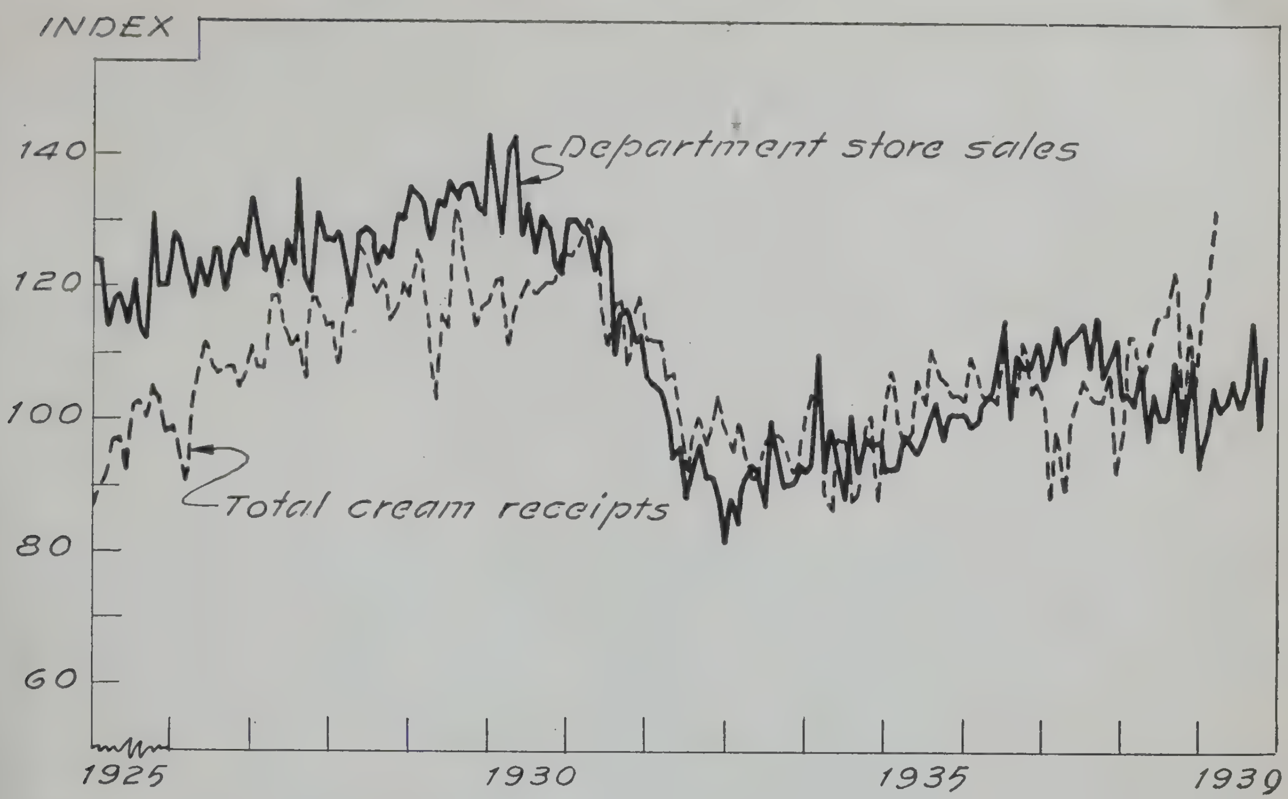

FIGURE 43. TOTAL CREAM RECEIPTS AT THE NEW YORK MARKET, AND NEW YORK AND BROOKLYN DEPARTMENT-STORE SALES TEN MONTHS EARLIER (1933–37 = 100)

but the population of the market area probably had increased about 9 per cent, so that less milk was consumed per capita.

Sales of Grade A milk reached a peak in 1930 and continued relatively high until early in 1932, when they dropped sharply. A slight increase in sales of Grade A occurred in 1934, and with the introduction of Vitamin D Grade A in 1935, sales recovered materially. In 1937, with the introduction of Vitamin D Grade B milk, sales of Grade A milk declined and have since continued on a downward trend.

Total sales of Grade B milk by dealers whose records were used in this study have fluctuated much the same as have the total receipts of milk at the market. Since 1935 the sales of Grade B milk through retail food stores have increased, while sales on retail routes have declined. This change is due to the decreased purchasing power of a large share of the consuming public and to the fact that milk has been sold by stores at lower prices. Since 1935 an increasing proportion of the milk sold through stores has been put up in paper containers, and although this milk has generally been priced 1 cent a quart higher, the greater convenience of the paper container as compared with glass bottles has tended to promote the store method of distribution.

Heavy cream makes up nearly two-thirds of the cream sold in New York City. About half of the cream is handled through retail food stores, and 35 per cent is sold to restaurants, hotels, and the like. Only about 15 per cent is delivered to consumers on retail milk routes. Sales of heavy cream for home consumption by New York City dealers did not fall off so much as did total receipts of cream during the depression, and have not shown as rapid recovery since. Apparently changes in the use of cream for making ice cream and cream cheese have followed a different pattern.

Seasonal variation in sales of milk and cream in the New York market are caused by two factors: the movement of large numbers of people out of the metropolitan area for vacations, and major temperature changes of the passing seasons. These factors act in opposition, since both the per capita consumption of milk and the number of persons going away on vacations increase as midsummer approaches. The sales of different products and of the same products in different types of packages and through different trade outlets are affected in varying degrees by the seasons, depending on the relative quantities used by different groups of consumers. Retail sales of quarts of Grade A milk vary only slightly except for a decrease during the summer months. This product is purchased by families with moderate to high incomes, and is consumed largely by children. The fact that it is consumed largely by children tends to prevent wide fluctuations, but the fact that most of the families buying it are able to go out of the city on long vacations causes a large reduction in sales during the summer months.

On the other hand, the sales of buttermilk increase strikingly during the summer. This product is purchased mainly by adults for lunch, and during the warmer seasons these consumers shift from hot to cold beverages. Relatively few of these consumers are able to be away during the summer for very long periods of time.

Because many retail food stores are closed all or part of Sunday, the store sales of milk and cream on Sunday are low in relation to the sales on other days of the week. This decrease in sales is nearly offset by increased sales on Friday, Saturday, and Monday.

Variations in sales of milk and cream due to holidays are of three types: decreased sales of some products on holidays which permit a portion of the population to leave town; increased sales of some products on holidays such as Thanksgiving and Christmas; increased or decreased sales on various religious holidays.

Changes of 1 cent a quart in the price of Grade B milk, either increase or decrease, appeared to have only a slight effect on the total sales. Because of the confusing effects of other factors, it was not possible to trace the influence of such price changes beyond the second or third week. Likewise, a 1-cent change in the price of half pints of heavy cream had only a slight effect on sales. On the other hand, changes of 2 cents or 3 cents per half pint in the price of cream caused a material increase or reduction in sales.

During the period of this study there were no changes of more than 1 cent in the price of milk on retail routes. There were, however, two occasions, in 1934 and in 1937, when the price of milk at stores declined rather sharply. In each of those instances there was a marked increase in the sales of milk at stores, without much change in the sales on retail routes.

There can be no doubt that the sales of milk and cream are affected to a considerable extent by changes in the consumers' purchasing power. However, the relationship between milk and cream sales and business activity, as measured by the *New York Times Index* or by department-store sales in New York and Brooklyn, is not as close as one might expect. Changes in total milk receipts at the market lagged about ten months behind the changes shown in the *New York Times Index*, and about five months behind changes in department-store sales. Cream receipts appear to lag about ten months behind changes in department-store sales.

Bulletin 736 June 1940

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Selective Factors in Migration from a New York Rural Community

Amy A. Gessner

In cooperation with
The Bureau of Agricultural Economics,
United States Department of Agriculture

UNION ACADEMY OF BELLEVILLE

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SELECTIVE FACTORS IN MIGRATION FROM A NEW YORK RURAL COMMUNITY[1]

AMY A. GESSNER

THE PROBLEM AND METHODS

IMPORTANCE OF RURAL-URBAN MIGRATION

Rural-urban migration has been a matter of concern since the beginning of the growth of modern cities. It is a problem which has troubled all the western nations for the past forty years. As early as 1896 Liberty Hyde Bailey wrote:

> One of the chief difficulties is the failure of country life as it exists at present to satisfy the higher social and intellectual aspirations of country people. Whether the constant draining away of so much of the best elements in the rural population into the towns is due chiefly to this cause or to the superior business opportunities of city life may be open to question, but no one can fail to recognize the necessity for building up the life of the farm upon its social as well as upon its productive side.[2]

This problem became increasingly troubling and focused attention upon the differential in satisfactions from rural and urban life. One result of the widespread concern over urbanward migration was the initiation of the country-life movement with its effort to enrich rural life through community organization. In his opening address to the First Wisconsin Country Life Conference, Dean Harry L. Russell said:

> Social sterility and temperamental attitude of mind have been in large measure, the primary cause for the drainage of the larger part of the vital resources of the country to the city. The necessity for stemming this tide is now recognized more forcibly than ever before. In order that the country shall continue to supply the city with brains, the virility of the original stock must be kept unimpaired, and to do this we must have some of the best remain in the country. Only when the country supplies the wants and needs of man, social and intellectual, as well as physical and material, when the prizes of the game of life are awarded in proportionate measures to those outside urban walls, then and then only will the call of the farm exert a sufficiently strong influence to hold a fair proportion of country youth.[3]

Tremendous change has come to rural areas, as well as to the nation as a whole, since these first alarms were sounded. How have these changes affected the character of the migration from rural areas? Has increased accessibility for rural people to the comforts of urban areas changed the trend which was so marked three decades ago? There is no simple answer to this question, so complex have been the forces operating upon agriculture and rural life since that time.

Many studies have been made of rural migration, with diverse conclusions regarding the selective nature of this migration. This diversity does not appear to be associated with time and the changes it brings, since recent studies differ among themselves rather than with earlier studies.

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[1] This bulletin is a condensation of the first part of a thesis presented to the Faculty of the Graduate School of Cornell University, September 1939, in partial fulfillment of the requirements for the degree of doctor of philosophy.

[2] Bailey, Liberty Hyde. Report of the Roosevelt Commission on Country Life. (Reference on p. 16.) February 9, 1907.

[3] First Wisconsin Country Life Conference. Univ. Wisconsin. Bul. 472. (Reference on p. 10.) February 1911.

The present study was designed to make a contribution to the research methods involved and to ascertain the facts for Belleville, and not to make any generalizations from the data for a single community.

Only one of the studies need be cited here, the first one made in the Belleville, New York, area.[4] It was not a study of selectivity, but rather of the amount of migration from the community, the distance of migration, and the achievements of some of the migrants, illustrating the importance of the rural community, "the very seed bed of national life." No comparisons were drawn between those who had remained in the community and those who had left except in the matter of occupation. However, the conclusion was drawn that because certain strong families had persisted in the community, and "community life itself has been positive, virile and progressive" folk depletion had not occurred as a result of migration. The group studied included all graduates of the local academy during the ninety-six years of its history.

It is a well-established fact that the whole population of the nation depends upon the quality of that in rural areas. These areas produce the surplus which fills in the ranks of urban dwellers who do not replace their numbers. If the city's superior opportunities, economic, educational, and social, have been causing folk depletion, all the nation's efforts to subsidize agriculture, to provide better educational opportunity, and to aid the community in enriching its own social and cultural life must be regarded as indispensable to maintaining the nation, for by these means are the rural communities made attractive to the able and ambitious.

THE PROBLEM

The object of this study was to answer two questions:

1. Are selective factors operating in the migration of rural young people from the community in which they were reared?
2. Are selective factors operating to differentiate between those who migrate to other rural areas and those who go to urban areas?

THE AREA STUDIED

The rural community of Belleville, New York, was selected as the field in which to seek the answer to the questions stated above for two major reasons. First, because this was the area covered by the earlier study.[5] Here was an opportunity to make some observations of the effects of time upon the extent and character of migration.

The second reason was the interest of the citizens themselves in the possible findings. Changes in such institutions as the church, the grange, and other organizations which once flourished in the community led those long resident there to question whether these changes were the effect of migration. So interested were the community leaders in this problem that they voted a portion of the income from the endowment fund of the local academy to aid in the study.

Two areas are covered by this study, one contained within the other. The first is the centralized school district of Union Academy, which includes the village of Belleville and the area within a five-mile radius on all

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[4] The national influence of a single farm community. By Emily F. Hoag. U. S. Agr. Dept. Bul. 884. 1921.

[5] See footnote 4.

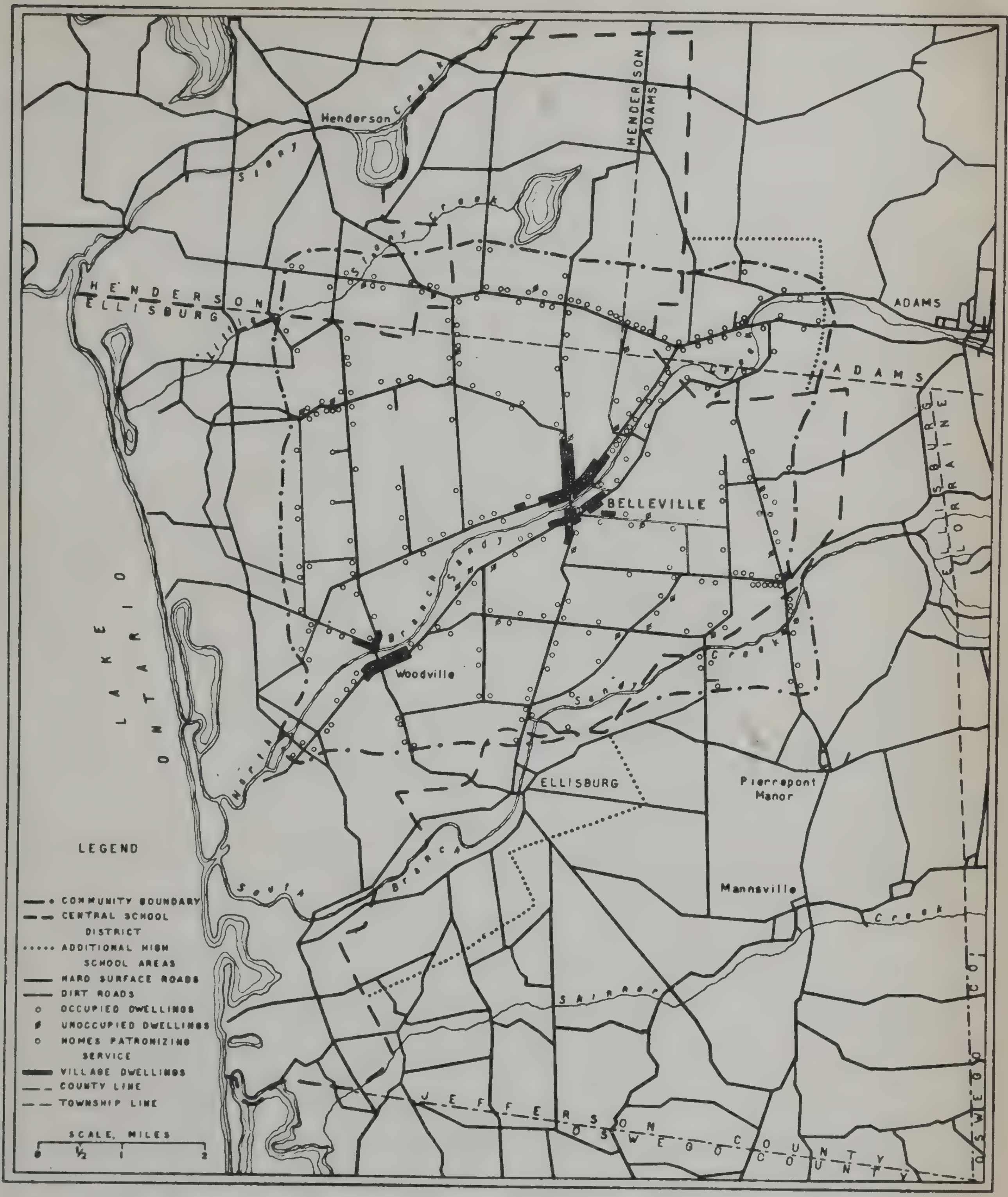

Figure 1. the belleville community and the central-school district

sides except the east, where it is limited to two or three miles. This school district covers parts of the towns of Ellisburg, Henderson, and Adams, in the southwestern corner of Jefferson County. The town of Ellisburg is bounded on the west by Lake Ontario, just south of Henderson Harbor. The second area is the Belleville community, the northern and eastern portion of the school district, and centering about the village of Belleville for a radius of three to five miles. This is the area from which most of the students came when the academy was a private school, and which Miss Hoag used for a large part of her study; the same boundaries were used in this study so that the data might be comparable.

Galpin, in *My Drift into Rural Sociology*, speaks of the village of Belleville as "a small hamlet—a spot of trade in among the farms of a great dairy country".[6] This is the richest agricultural area of the county and one of the best in the State. The western part of the area closer to the lake is sandy and not quite so desirable agriculturally as the section farther east. The smaller area of the community, as contrasted with that of the district, includes none of the sandy soil; all the soil is of superior quality.

The village itself, with a population of a little more than 300, is no longer incorporated. It serves a limited trade area for groceries, garage service, church, and grange. Its school area is considerably larger than its trade area. It lies five miles west of Adams, a growing trade center of 1600, which includes the Belleville community in its banking, milk-marketing, and motion-picture area. Belleville is 25 miles south of Watertown, the county seat, a prosperous city of 32,000 which is a shopping and medical center for a large area, including Belleville. A few of the residents of the Belleville area drive to work in Watertown each day.

Belleville is an old and long-established community, rich in history and tradition, particularly its tradition for education. Its early settlers from eastern New York and New England brought to it a high regard for education and religion. First settled in 1802, it had a school by 1805, and the Baptist church was organized in 1807. The Union Academy, around which the community's life has always centered, had its beginnings in 1824, then under the name of the Union Literary Society.

The character of the population which this community had attracted to it was evidenced in the support which it gave this school. The present endowment fund is $74,000. But the value which the citizens placed upon education was also evidenced in the steady increase in enrollment. The majority of those attending have been the sons and daughters of farmers, and farmers have supported and controlled it.

THE METHOD OF STUDY

It is probable that no other trait is more valued in society today than mental ability. There could be no more significant thing on which to compare the migrant with the non-migrant in the community's own terms. But the widely accepted measure of mental ability, the intelligence-test score, was not available. However, complete records of high-school grades could be obtained for the younger migrants. Only those who had spent one year or more at Union Academy between the years 1919 to 1938 were included in the study. The study was begun with the year 1919 because Miss Hoag's study covered up to that time. The data were gathered in July and August of 1938, which set the upper limit of the study.

A card was made for each student who had entered the academy between 1919 and 1938 and remained one year or more. The alumni records, the principal of the school, old residents, and relatives of the one-time student were consulted for information regarding the address and occupation of the student. Of course, many of the students were still in the community area and their homes were visited in the process of the field study described below. Those who were not reached by the field schedule were sent a questionnaire and a letter asking for their cooperation. Satisfactory comparison between the migrant and non-migrant young people could have been made only on the basis of achievement in high school as measured by grades, and by age and sex, all of which were available from the school records. However, it was deemed advisable to send the questionnaire to each student to check the information on his present place of residence as furnished by the local citizens and to obtain additional information. A summary of the questionnaire returns is given under the description of the sample.

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[6] Galpin, Charles J. My drift into rural sociology, p. 5. Univ. Louisiana Press. 1938.

The students were also listed on tabulation sheets according to the calendar year in which they entered Union Academy. Age and sex were recorded. Averages for each year's work while at Union Academy were computed and entered for each student. The classes averaged 26 pupils for each grade. The student was given a rank for each year's work, depending upon his position in relation to his fellow classmates. Then these ranks were averaged to give him an average rank for his whole high-school career. The next step was to group the class with which he finished into fourths according to rank, and his final position was thus established on the basis of his average rank in an upper or lower fourth of the class. For example, a student might rank second in his freshman year, fourth as a sophomore, fourth as a junior, and second in his senior year. This would give him an average rank of third, which would put him in the top fourth in any of the classes.

Students who did not complete a full academic year were not included because of insufficient records for averaging and ranking. However, because students who had spent but one year were included, the final position for some was established on the basis of fewer years' work than for others. Courses of study differed to some extent for different students, but in a school of this size, a little more than 100 pupils, on the average, there is not a great variety of offerings.

The second major phase of this study (not fully reported in this bulletin), the comparison of the families long established in the community with the more recent immigrants, was approached by the use of a field schedule. These schedules contributed data on the parental homes, which were compared with information about those migrant and non-migrant students whose homes were covered by the study.

The data from the returned questionnaires, field schedules, and school records were transferred to Hollerith cards, and tabulations were made by machine.

THE SAMPLE STUDIED

The high-school records supplied data on a total of 494 students who entered between September 1919 and September 1938. There was a preponderance of females among them, in accordance with the expectation for rural high schools. Their present ages range from 15 to 37 with an average age of 25 years. Of this total, 75 are still attending Union Academy, 243 have left the school district, and 173 are still in the district. Of these 173, 17 are away at school but their parents are still in the district and the students are not considered as having left. Of the 243 who have left, 8 are still in high school, and 2 are attending trade school or college.

Present distribution of 494 students of Union Academy, 1919–38

Still attending Union Academy	75
Deceased	3
Left school district	243
Still in school district	173

No address was obtainable for 18 of the former students who had left the area, and no questionnaires were sent to those still in high school. Therefore questionnaires were sent to 217 of those who had left. Questionnaires were sent to 54 of the 173 still in the school district because they were not in the area covered by the field schedule. Replies were received from 69 of the 217 and from 13 of the 54. Fourteen questionnaires addressed to those who had left the district were returned because of incorrect address. Therefore 82 replies were returned from the 257 who actually received questionnaires, making a return of 32 per cent for the data on the questionnaires.

The facts concerning migration and school rank did not depend on the questionnaires, but involved more than two-thirds of the total pupils studied. The 83 students still in high school and the three who had died have not been included in the tabulations. For the purpose of this report it was also decided to omit the 69 former students who left the community with their parents, because they did not migrate voluntarily. This leaves a basic sample of 339, or 68 per cent of the total, for whom data on migration and school ranks are available. The samples for the other factors vary, depending upon the source of information concerning them. Information on all factors analyzed is available for the 105 students covered by the field schedule. Almost complete information was obtained about the 82 who answered the questionnaires. Some factors were covered for the 43 students who had left the area, and who did not answer the questionnaire, but whose parents were included in the area of field study. Consequently the sample reported on varies from factor to factor. Where failure to obtain data on a certain factor for the whole group introduces a possible bias, this is discussed in connection with that factor.

Families in the community

The field schedule was obtained from 397 families, all except one resident in the area included within the boundaries established in Miss Hoag's study. Though the community boundaries have changed, as explained in the section on the community, it seemed desirable to follow the limits set by the previous study for the sake of comparison.

Two hundred of these families lived on farms in the open country, 63 in non-farm homes in the open country, 117 in village homes in Belleville or Woodville, and 17 in farm homes within the village limits. Neither Belleville nor Woodville is an incorporated village, but for Belleville the limits of the now dissolved corporation were applied, and in Woodville, those homes which were closely centered about the service agencies of the hamlet were classified as village homes.

This field schedule included data on the membership of the family, tenure status, income, mobility, organization membership and participation, trade centers patronized, residence, occupation, and education of sons and daughters who had left the community.

FACTORS AFFECTING MIGRATION

EXTENT OF MIGRATION

For more than a century Union Academy has been training the boys and girls of the Belleville community for life on the farms and in the villages of the community as well as in distant cities and even foreign lands. It is interesting to find that the proportion of migrants from the community among the students registered in the years 1919 to 1938 is almost identical with the proportion among those of the period 1824 to 1919. Fifty-four per cent of the first group studied had migrated, compared with forty-nine per cent of the more recent students.

A good deal of Miss Hoag's study was devoted to an analysis of the distance of migration and the size of the community lived in. There has been little change in this distribution when the two studies are compared. She classified her sample by the size of the community in or near which the former students resided, so that the number living on farms is not known. She found that 47 per cent were living in or near centers of 5000 or more. In the present study it was found that only 19 per cent were living in centers of 2500 or more. Some of the difference may be due to her classification of the place of residence by the post office from which mail was received, but it seems doubtful that all the difference could be attributed to this fact. Of course, a larger proportion of the present sample will eventually go to urban areas. However, this difference may indicate a lessening of urbanward migration from this community.

Comparison of distance of migration is given in the table below. It will be seen that the more recent group tends to show a slightly more limited range of migration, which may be attributable to a larger proportion of adolescents among them.

TABLE 1. DISTANCE OF MIGRATION OF FORMER STUDENTS ATTENDING UNION ACADEMY BETWEEN 1824 AND 1919, COMPARED WITH THOSE ATTENDING BETWEEN 1919 AND 1938

	Hoag sample 1824–1919*	Present study 1919–1938
	Per cent	*Per cent*
In foreign countries	2	0
In United States outside New York State	17	6
In New York State outside Jefferson County	15	21
In Jefferson County outside community or district	20	26
Still in the community	46	47
Total	100	100

*See footnote 4, page 4.

In both groups, about half of the students have left the district, and half have remained. What are the differences between these two groups? They are analyzed in this section for the factors of age, sex, achievement in school, number of years of schooling, whether farm- or village-reared, and for certain factors in the parental home.

AGE IN RELATION TO PRESENT PLACE OF RESIDENCE

Writers on rural life frequently comment on the fact that the community is being bled by the city of its brightest manhood and womanhood in the vigor of their youth, leaving the dependent young and old in the rural areas to be supported by a smaller proportion of productive workers. This study cannot contribute much information on this matter of age selection in migration for two reasons: first, because of the nature of the sample. The age range is limited by the fact that it was chosen to cover only a time section (19 years) of the students who have attended Union Academy. In fact, the whole group covered by this study might well be regarded as young people. Their average age at the present time is 25 and the range is from 15 to 37. Secondly, the ages at which the now older migrants left are not known. This question was omitted from the questionnaire for the sake of brevity. Migrants and non-migrants within a very limited age range are compared, and consequently there is a reversal of the generalization made by most investigators of this problem.

These data are most useful, however, in indicating what changes may be expected in the migrations of the group now in the community as they grow older. The proportions from the older age groups which have migrated may be some measure of what can be expected for the younger portion of the sample.

The analysis of the age factor in relation to these migrants and non-migrants is also interesting in view of the theory frequently advanced in connection with youth studies that the young people of rural communities are no longer leaving those communities, because of the curtailment of opportunities elsewhere.

In table 2 is shown a pronounced difference in age between those who are still in the area and those who left. Half of the migrants are over 25, whereas only 43 per cent of the tota sample are in that age group. Six of each ten of those under 21 are still in the district. The older they are the more likely they are to be outside the district. As these former students grow older more of them will leave the district. Thus it would appear that when it is said that the district now has about 50 per cent of those it educates, it must be recognized that they are not all in their most productive years. At any time there will be 50 per cent of the former students of the school resident in the district, but that will always include a large number just out of school, who will eventually migrate.

If this particular group were resurveyed ten years from now the majority would be close to the peak of their productive years, and a considerable difference would be found in the proportions of migrants.

Estimates were made on the basis of the figures in table 2 for the probable situation ten years from now. The group now 15 to 17 years of age will be 25 to 27, and accordingly 47.3 per cent, or 10 of them, will be gone. The same proportion of the group now 18 to 20 will then be gone, or 29 persons. Sixty-nine per cent of the group now 21 to 25 will be gone, or 73 persons. Two-thirds of those now 26 to 30 will be gone, or 61 of that group. Although the increases for the two oldest groups cannot be estimated, a total of 209 of the students now out of school will be gone. Since 70 per cent of those in the older-age groups who have gone away to school have left, 11 more should be added to the 209 to get the total number who will be gone 10 years from now. This gives a total of 220 migrants, or 66 per cent. Therefore the district stands to lose many more of this group of former students.

By comparing the size of the communities lived in at the present time by the various age groups it is possible to obtain some idea of where these

TABLE 2. AGE OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION WITHIN OR OUTSIDE THE SCHOOL DISTRICT

Present age in years	Present location			
		Not in school		Away at school
	Total	In the district	Outside the district	Parents in the district
	Number	*Number*	*Number*	*Number*
Total	331	156	158	17
15–17	22	13	4	5
18–20	62	36	20	6
21–25	104	43	55	6
26–30	91	48	43	0
31–35	49	15	34	0
36–37	3	1	2	0
	Distribution of present location by age classes			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
15–17	7	8	3	29
18–20	19	23	13	35
21–25	30	28	34	36
26–30	28	30	27	0
31–35	15	10	22	0
36–37	1	1	1	0
	Distribution of age classes by present location			
Total or average	100	47	48	5
15–17	100	59	18	23
18–20	100	58	32	10
21–25	100	41	53	6
26–30	100	53	47	0
31–35	100	31	69	0
36–37	100	*	*	*

*Numbers too small to figure percentages on them.

younger folks who are likely to leave the community will go. It can be seen from table 3 that more of the younger individuals reside in rural areas and more of the older ones in cities. Fifty-eight per cent of those residing in cities are over 25, but only 43 per cent of the whole sample are over 25. Furthermore 31 per cent of those residing in rural areas are under 21, but only 8 per cent of those in cities are under 21.

This tendency for the older migrants to live in larger centers suggests that if complete data had been obtained on their moves from place to place, support might have been found for the theory that migration proceeds outward from an area in wavelike movements. These younger people who are still in smaller centers may through subsequent moves finally reach the city.

The association between age and present location suggests that more of this sample will be residents of cities ten years from now than at the present time. It is estimated that ten years from now 25 to 30 per cent of these former students will be city dwellers, instead of 19 per cent as at the present time, assuming no fundamental change in general conditions in that period.

TABLE 3. AGE IN RELATION TO PRESENT LOCATION OF FORMER STUDENTS ON FARMS, IN VILLAGES AND IN NON-FARM HOMES, OR IN URBAN AREAS

Present age	Total	Present location				
		On farms	In villages and non-farm homes	Total in rural areas	In cities	In the army or navy
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Total........	317	139	110	249	59	9
15–17............	21	11	8	19	2	0
18–20............	62	39	19	58	3	1
21–25............	97	41	31	72	20	5
26–30............	87	31	36	67	20	0
31–35............	47	15	15	30	14	3
36–37............	3	2	1	3	0	0
	Distribution of place of residence by age classes					
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total........	100	100	100	100	100	100
15–17............	7	8	7	8	3	0
18–20............	20	28	17	23	5	*
21–25............	30	30	28	29	34	*
26–30............	27	22	33	27	34	0
31–35............	15	11	14	12	24	*
36–37............	1	1	1	1	0	0
	Distribution of age classes by place of residence					
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average.....	100	43	35	79	19	3
15–17............	100	52	38	91	10	0
18–20............	100	62	31	94	5	2
21–25............	100	42	32	74	21	5
26–30............	100	36	41	77	23	0
31–35............	100	32	32	64	30	6
36–37............	100	67	33	100	0	0

*Numbers too small to figure percentages on them.

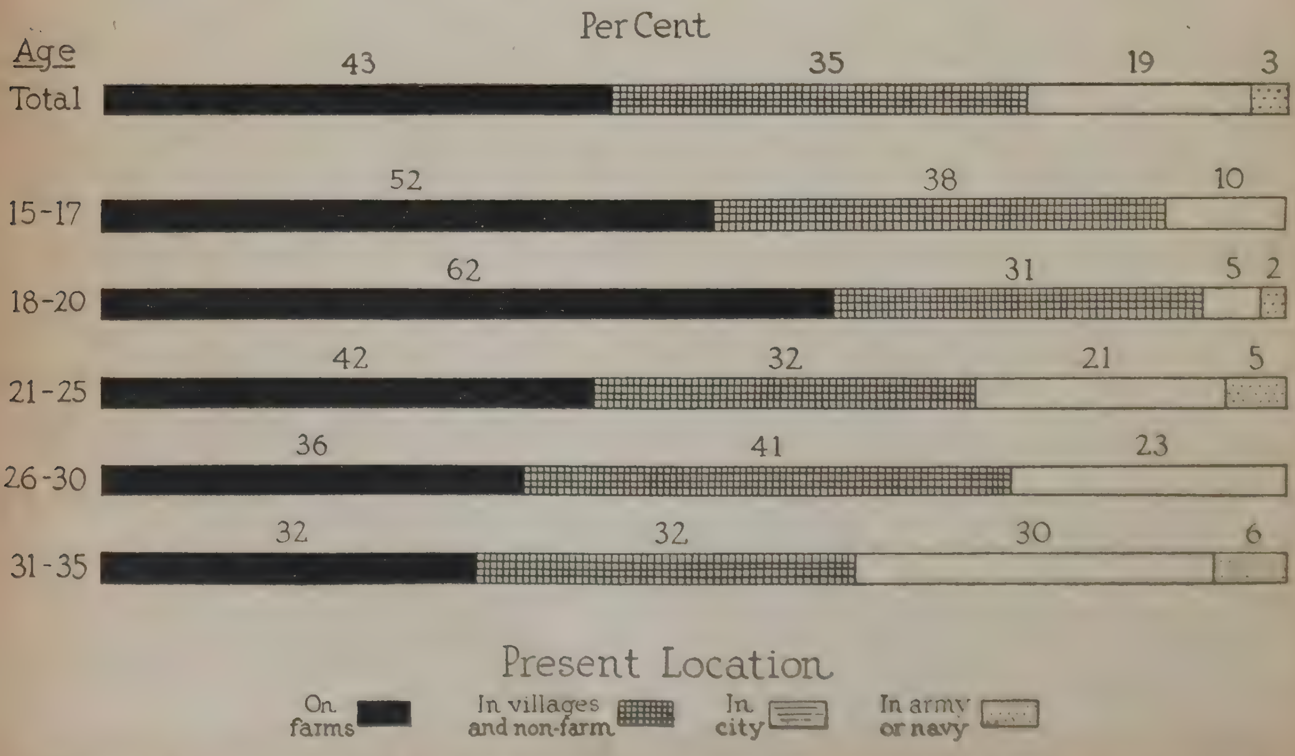

FIGURE 2. RELATION OF AGE OF FORMER STUDENTS TO PRESENT PLACE OF RESIDENCE

To carry the analysis further, rural residents are classed in two groups: those on farms and those in villages and in non-farm residences. In table 3 it is shown that the farms have the largest proportions from the younger age groups. Only 34 per cent of these former students who are on farms are over 25, and 38 per cent of those in villages, whereas 58 per cent of those in urban areas are in that group. Thirty-six per cent of those on farms are under 21, and 25 per cent of those in villages, but only eight per cent of those in cities are under 21.

In summary, age is a factor to some extent associated with migration of these former students of Union Academy. It is related to movement from the district, and from this rural area to cities. It is evident that this study can be regarded only as a cross-section in time. It is representative of the situation of the district for any similar period of time. It is certain that the migration described above does not indicate the total migration which this particular group of students will make.

SEX IN RELATION TO PRESENT PLACE OF RESIDENCE

It was one of the classic laws of migration formulated by Ravenstein that "females are more migratory than males".[7] Many studies of rural-urban migration indicate that a considerably larger proportion of females than of males leave the farms and rural areas for the city. Cities furnish increasing vocational opportunities for women. The rural areas offer little opportunity for economic independence or vocational achievement to young women, aside from teaching school.

Some features of this sample need to be pointed out before discussing the data on the subject of sex selection. Information for all individuals was obtained on the factor of sex. However, because information on the size of the community lived in at present is not known for 27 persons, the sample is cut down somewhat in the tables on distribution according to the size of present place of residence.

TABLE 4. SEX OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION WITHIN OR OUTSIDE THE SCHOOL DISTRICT

Sex	Total	Present location		
		Not in school		Away at school
		In the district	Outside the district	Parents in district
	Number	*Number*	*Number*	*Number*
Total	339	156	166	17
Male	152	77	67	8
Female	187	79	99	9
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Male	45	49	40	47
Female	55	51	60	53
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	46	49	5
Male	100	51	44	5
Female	100	42	53	5

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[7] Ravenstein, E. G. The laws of migration. Royal Statis. Soc. Journ. **48**: 167–235. 1885.

It will be seen upon reference to table 4 that there are eleven per cent more females than males in this group of former students. Attendance at high school in this rural area has apparently been somewhat more a privilege of the girls than of the boys because a check of census figures for 1930 shows a preponderance of males in the county, in the age groups which would have contributed to the high-school group. There seems little reason to believe that this particular area should be strikingly different from the other sections of the county in its sex ratio, and it must have as many or more males than females. It must be reasoned, therefore, that high-school attendance for one year or more operates as a sex-selective factor in this rural high school.

This picture is not changing, since a tally reveals that all of the last five classes entering had a small preponderance of females. One possible explanation is that farm boys who finish eight grades are past the age of compulsory attendance and drop out of school without entering high school. Also more of the boys who entered high school at 15 dropped out of school when they became 16 without finishing the year. The girl feels she needs high school more for preparation for the vocation she will enter, whereas the boy who is learning his vocation by working with his father on the home farm, may feel that further schooling will not help him. Or, again, it may not be a volitional matter, but rather that the boy must leave school as soon as the law allows because he is needed on the farm.

As a result of this preponderance of females in the sample, they comprise a larger proportion than do the males both of those still in the community and of those who have left. However, nineteen per cent more of those who have left are females, compared with only one per cent more females among those still in the district. Stated another way, nine per cent more of the girls than of the boys have left the district.

Do the female migrants go to other rural areas or migrate to the cities? Data on rural and urban residence in relation to the factor of sex are given in table 5. The proportion of females among those resident in cities exceeds the proportion of males by 33 per cent, but among those resident in rural areas, the proportion of females exceeds the proportion of males by only 7 per cent. Nine per cent more of the females than of the males are now resident in cities.

Grouping the rural residents into farm, and village and non-farm, gives an interesting reversal of proportions (table 6). For the first time one of the categories shows a preponderance of males, and that is among the farm residents. Eleven per cent more of those on farms are males. The greatest difference in the proportions of the sexes is found among the village and non-farm residents. There the females exceed the males by almost thirty per cent. Seventeen per cent more of the boys than of the girls reside on farms, but fourteen per cent more of the girls reside in villages or in non-farm residences, and nine per cent more of the girls than of the boys are in cities.

A special tally shows that the preponderance of males on farms is due to the preponderance of males among those who have remained on farms in the district. When those on farms in the district are compared with those on farms outside the district it is found that men and women have moved in equal numbers to farms outside, but that larger numbers of the women than of the men have left the farms in this district. The farms of

TABLE 5. SEX OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION IN RURAL OR URBAN AREAS

Sex	Total	Present location		
		In rural areas	In cities	In army or navy
	Number	*Number*	*Number*	*Number*
Total	324	253	62	9
Male	147	117	21	9
Female	177	136	41	0
	Distribution of present location by sexes			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Male	45	46	34	100
Female	55	54	66	0
	Distribution of sexes by present location			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	78	19	3
Male	100	80*	14*	6
Female	100	77*	23*	0

*These percentages are not directly comparable because of the 6 per cent of males in the army and navy. However, if this is eliminated the percentage of males in cities would be 15 and in rural areas 85. So far as migration is concerned, members of the army and navy may legitimately be classed with those in cities, in contrast to those in rural areas.

TABLE 6. SEX OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION ON FARMS, IN VILLAGES AND IN NON-FARM HOMES, OR IN URBAN AREAS

Sex	Total	Present location			
		On farms	In villages and in non-farm homes	In cities	In the army or navy
	Number	*Number*	*Number*	*Number*	*Number*
Total	324	139	114	62	9
Male	147	77	40	21	9
Female	177	62	74	41	0
	Distribution of present location by sexes				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	110	100	100	100
Male	45	55	35	34	100
Female	55	45	65	66	0
	Distribution of sexes by present location				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	43	35	19	3
Male	100	53	27	14	6
Female	100	35	42	23	0

the district sent more girls than boys to high school, but of the former students now residing on farms many more are men. Fifty-seven of a hundred former students now resident on farms in the district are males, but only forty-three of a hundred students resident on farms at the time of attending high school were males.

Almost all investigators find that males migrate greater distances than do females. The distance of migration from the school district in relation to sex is shown in table 7. These data support the findings of other investigators so far as movement outside the State is concerned. Males exceed females by fifty-five per cent among those who have left the State. This difference in proportion is reversed in the case of the group resident in other parts of Jefferson County outside the adjacent townships. The preponderance of females in this case is accounted for by their number in the city of Watertown, the county seat.

TABLE 7. SEX OF FORMER STUDENTS IN RELATION TO THE DISTANCE FROM THE SCHOOL DISTRICT OF THEIR PRESENT LOCATION

Sex	Total	Distance from the district					
		In the school district	In adjacent townships	Elsewhere in Jefferson County	In adjacent counties	Elsewhere in New York State	Elsewhere in the United States
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Total	325	173	38	36	18	42	18
Male	147	85	21	8	4	15	14
Female	178	88	17	28	14	27	4
	Distribution of distance from the district by sexes						
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100	100	100
Male	45	49	55	22	22	36	78
Female	55	51	45	78	78	64	22
	Distribution of sexes by distance from the district						
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	52	12	11	6	13	6
Male	100	58	14	5	3	10	10
Female	100	49	10	16	8	15	2

It is evident from these data that there are sex differences in distance of migration. More of the women have migrated greater distances from the district until state boundaries are reached, but beyond that the men predominate among the migrants.

In summary of this section on sex as a factor in migration, using migrant and non-migrant for comparison, it can be said:

1. There are 11 per cent more women than men in this group of former high-school students.
2. Nine per cent more of the women than of the men have migrated from the district and are not now in school.

3. Nine per cent more of the women than of the men have migrated to cities.
4. A much smaller proportion of the women than of the men are on farms. It is true, of course, that a slightly larger proportion of the men than of the women lived on farms while going to high school, but the difference was not nearly as great as between the proportions of the two sexes now residing on farms, which is 17 per cent.
5. The proportion of these women students now living in villages or in non-farm residences exceeds the proportion of males residing there by 15 per cent.
6. A larger proportion of the women students have migrated from the county but a larger proportion of the men have gone outside the State.

ACHIEVEMENT IN SCHOOL WORK IN RELATION TO MIGRATION

One of the primary purposes of this study is to test the hypothesis that rural-urban migration is increasing the proportion of the less mentally able in the rural population because the city attracts the most capable rural young people. Various measures have been used in comparing the ability of migrants and non-migrants. Gist and Clark used the results of Terman Intelligence Tests taken in rural high schools.[8] Otto Klineberg used an average of school grades at elementary level.[9] Mueller, in his study of migrants from villages in Germany, used the grades in the three subjects which all students were required to take.[10] Almost all studies compare migrants with non-migrants on the basis of the number of years of schooling they have had. Occupations followed by migrants and non-migrants are widely used as indicators of mental ability.

In this study grades achieved in high school have been used as indicators of certain qualities, attitudes, and achievements, the decrease of which in any great degree impoverishes a community.

It is recognized that school achievement cannot be safely used as a measure of "intelligence", if the latter implies innate mental ability. Furthermore, it is recognized that bookish and docile pupils tend to favor formal school studies and to go into vocations for which their scholastic accomplishments qualify them. It is also true that formal schooling is an index of social and economic factors as well as aptitude for education, which factors have not been associated in this study except as indicated by the schooling of the parents.[11] In spite of these qualifications it is true that there is a considerable mass of evidence, not however undisputed, that amount of schooling and achievement in school studies are related to achievement in later life, and that scholastic ability is, by and large, as good an index of mental ability as has yet been found. It may well be that a different type of mental ability and other personality characteristics are more essential for farming than for the occupations in which scholastic ability is important. Ratings of scholastic ability have been developed to measure the latter rather than the former. It is possible that those superior scholastically might not make as successful farmers as do those with lower school grades but who are superior in other characteristics essential for agriculture; but this is a hypothesis which requires verification.

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[8] Gist, Noel P., and Clark, Carroll D. Intelligence as a selective factor in rural-urban migrations. Amer. journ. soc. **44**: 36–58. 1938.

Professor Gist writes that he and his collaborators, Pihlblad and Gregory, have collected data on approximately 5000 former high-school students with their grades and movement and occupational choice. He advises that the scholastic index of former high-school students who migrated to urban communities is significantly higher than the index for individuals who are now living on farms. The sample representing rural-non-farm communities has a higher index than that of the farm group but is slightly lower than for the urban group. He expects to publish a report on these data shortly.

[9] Klineberg, Otto. The intelligence of migrants. Amer. soc. rev. **3**:218–224. 1936.

[10] Mueller, Josef. Siebungvorgange bei der abwanderung vom dorfe. Archiv fur Bevolkerungswissenschaft (Volkskunde) und Bevolkerungspolitik **7^1**:33–54. 1937.

[11] Selective character in American education, by George G. Counts. 1922.

For the ideas embodied in this paragraph the author is indebted to Dr. Thomas L. Bayne of the Department of Rural Education, Cornell University.

The section on method explains how the grades achieved in high school were used in locating the students in ranks by fourths. It will be recalled that position in the first, or upper, fourth means greater success, while the lowest fourth indicates low position in relation to fellow classmates.

These ranks by fourths were established for some on the basis of only one year's record while for others grades for four or five years were used, depending upon the period of attendance at the academy.

It will be seen from table 8 that those who have spent fewer years at Union Academy tend to be somewhat less able academically.

This raises the question whether some of the lower ranking is due to change to a new school or actually to less ability. However, a study of the record of these students shows that 40 of them, or less than 10 per cent, enrolled in Union Academy after their freshman year. A check of the average ranks of these students reveals that they have a wide range and several of them do overcome the disadvantage of transfer in the middle of their high-school careers and do obtain better than average ranks.

TABLE 8. NUMBER OF YEARS SPENT AT UNION ACADEMY BY FORMER STUDENTS, IN RELATION TO RANK BY FOURTHS IN CLASS

Rank in fourths of class	Total	Number of years at Union Academy					
		1	2	3	4	5	6
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Total	408	91	68	51	117	77	4
1	100	12	7	17	43	21	0
2	100	14	19	9	34	24	0
3	101	16	14	15	29	24	3
4	107	49	28	10	11	8	1
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100	100	100
1	24	13	10	33	37	27	0
2	25	15	28	18	29	32	0
3	25	18	21	29	25	31	75
4	26	54	41	20	9	10	25

Far more of the short terms of attendance at Union Academy are due to dropping out or removal after starting as freshmen; hence, so far as short terms of attendance at Union Academy are associated with lower grades, little of this can be attributed to mobility.

Class rank and migration from the community

Though low grades do not appear to be related to mobility in the parental household, what of their relation to the migration of the student himself? In table 9 is given the rank distribution of this group of former students on the basis of whether they are still in the district.[12]

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[12] It will be noticed that these fourths are not even. This is due to the fact that no students were eliminated at the time the divisions of the classes into fourths were made. Since then the students still in high school, the deceased, and those who left with their parents have been removed from the sample, with the result that by chance a greater number was taken from the second and fourth fourths than from the first and third.

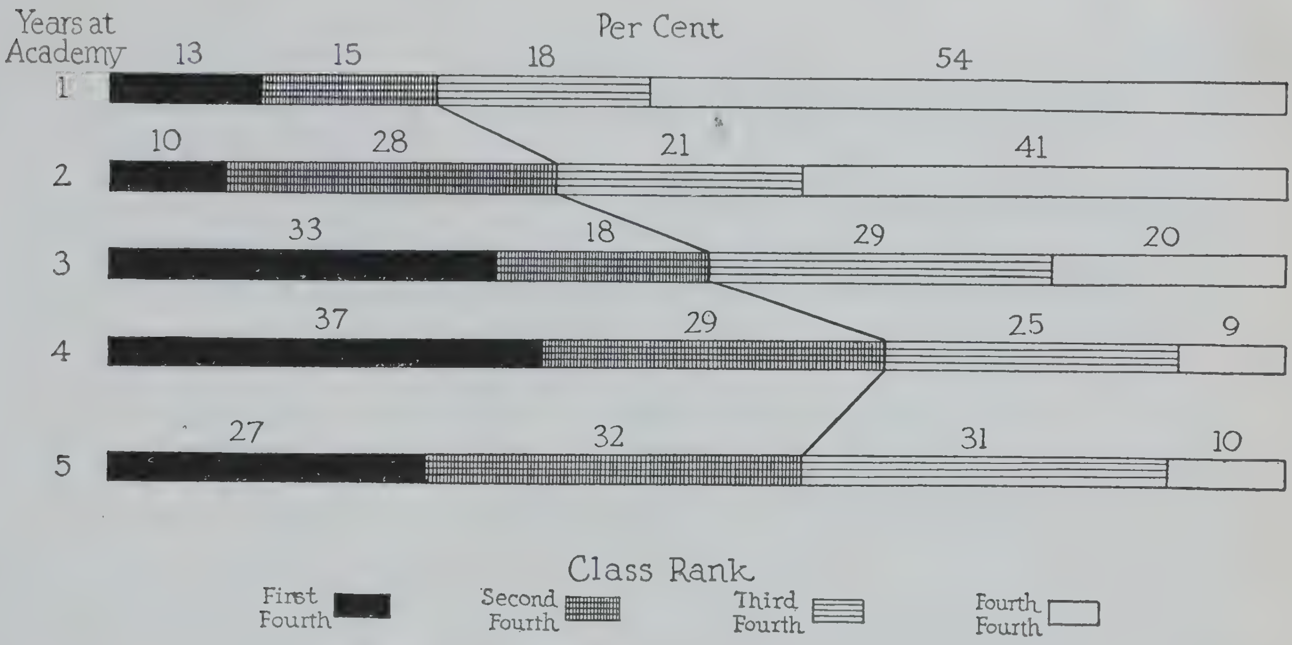

FIGURE 3. PERCENTAGE OF FORMER STUDENTS IN DIFFERENT CLASS RANKS, BY NUMBER OF YEARS IN BELLEVILLE UNION ACADEMY

TABLE 9. Rank by Fourths of Class of Former Students in Relation to Present Location within or outside the School District

Rank in fourths of class	Total	Present location		
		Not in school		Away at school
		In the district	Outside the district	Parents in district
	Number	*Number*	*Number*	*Number*
Total	339	156	166	17
1	86	35	41	10
2	84	34	46	4
3	87	39	47	1
4	82	48	32	2
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
1	25	22	25	58
2	25	22	28	24
3	26	25	28	6
4	24	31	19	12

The evidence in table 9 seems to indicate a slight trend for more of those with higher class rank to leave the district. The interpretation is complicated by the fact that 17 are now away at school, and they cannot be fairly classed as residing either within or outside the district, for two-thirds of them (see table 19) will leave the district as soon as they finish their schooling, while four-fifths of them rank in the upper half. If they are classed as residing in the district, which is their legal residence, the proportion of those with high grades residing in the district is unduly raised. Therefore those away at school are classed as two-thirds resident outside the district and one-third within, which seems the most equitable manner of taking them into consideration. When this is done, the upper and lower halves by class rank are distributed as to residence as shown in table

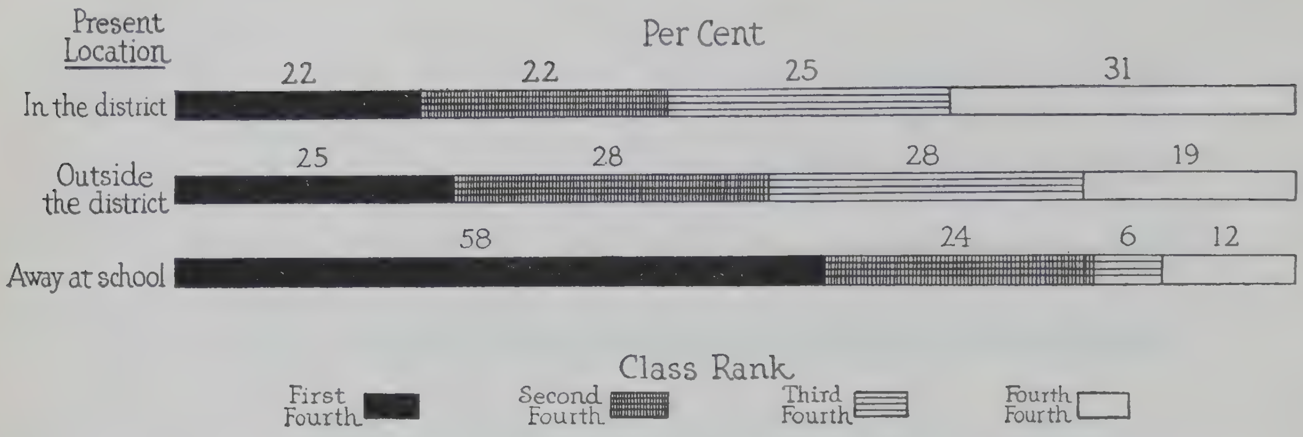

FIGURE 4. PERCENTAGE OF FORMER STUDENTS IN DIFFERENT CLASS RANKS, BY PRESENT PLACE OF RESIDENCE INSIDE OR OUTSIDE THE DISTRICT

TABLE 10. RANK OF FORMER STUDENTS IN UPPER AND LOWER HALVES IN RELATION TO PRESENT LOCATION WITHIN OR OUTSIDE THE SCHOOL DISTRICT, ADJUSTED FOR THOSE AWAY AT SCHOOL*

Class rank	Total	Present location	
		In the district	Outside the district
	Number	*Number*	*Number*
Total	339	161	178
Upper half	170	73	97
Lower half	169	88	81
	Per cent	*Per cent*	*Per cent*
Total	100	100	100
Upper half	50	45	54
Lower half	50	55	46

*Coefficient of association =0.11

10. This indicates a very slight degree of association between rank and present place of residence.

It has been shown (table 8) that many of those who do not complete high school are in the lower half of their class rank, and that those who complete four years of high school, or more, have the higher ranks and are more likely to leave the community. This raised the question as to whether those who drop out of high school might show more tendency to remain in the district and thus account for more of the students with lower class rank to be found in the district. These relations were tabulated and are given in tables 11 and 12, which include only the 339 students who did not migrate with their parents. Table 12 was computed by classing those away at school with those residing within and outside the district, as was done in table 10. These tables show clearly that of those who remain in high school only one to three years a larger proportion of those with low grades tend to remain in the district. Taking them as a total (158 in number), there is a coefficient of association of 0.31 between residence in the district and lower class rank, as compared with residence outside the district and higher class rank.

On the other hand, those who complete four years of high school and go no further are much less likely to show this trend, the coefficient of association being only 0.20 (though this may be due to chance); while those

TABLE 11. RELATION OF YEARS IN HIGH SCHOOL AND SCHOOLING BEYOND HIGH SCHOOL TO CLASS RANK AND PRESENT RESIDENCE INSIDE OR OUTSIDE THE DISTRICT

Class rank in fourths	Years in high school															College or trade school		
	One year only			Two years only			Three years only			Total less than four years			Four years only					
	Inside district	Outside district	Away at school	Inside district	Outside district	Away at school	Inside district	Outside district	Away at school	Inside district	Outside district	Away at school	Inside district	Outside district	Away at school	Inside district	Outside district	Away at school
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
1.......	3	6	0	2	4	0	3	7	3	8	17	3	19	10	3	8	13	4
2.......	4	5	0	4	11	1	2	5	0	10	21	1	19	18	2	3	5	1
3.......	2	7	0	3	8	0	6	8	0	11	23	0	22	14	1	3	6	0
4.......	21	13	0	11	11	0	3	4	1	35	28	1	10	3	1	2	0	0
Total.	30	31	0	20	34	1	14	24	4	64	89	5	70	45	7	16	24	5
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1.......	10	19	0	10	12	0	21	29	75	12	19	60	27	22	43	50	54	80
2.......	13	16	0	20	32	0	14	21	0	16	24	20	27	40	29	19	21	20
3.......	7	23	0	15	24	0	43	33	0	17	26	0	31	31	14	19	25	0
4.......	70	42	0	55	32	0	21	17	25	55	31	20	14	7	14	12	0	0
Total.	100	100	0	100	100	0	100	100	100	100	100	100	100	100	100	100	100	100

TABLE 12. RELATION OF YEARS IN HIGH SCHOOL AND SCHOOLING BEYOND HIGH SCHOOL TO CLASS RANK AND PRESENT RESIDENCE INSIDE OR OUTSIDE THE DISTRICT, CORRECTED BY ALLOCATING THOSE AWAY AT SCHOOL TO RESIDENCE WITHIN OR OUTSIDE THE DISTRICT

Class rank	Years in high school										College or trade school	
	One year only		Two years only		Three years only		Total less than four years		Four years only			
	Inside district	Outside district	Inside district	Outside district	Inside district	Outside district	Inside district	Outside district	Inside district	Outside district	Inside district	Outside district
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Upper half	7	11	6	16	6	14	19	41	39	32	9	22
Lower half	23	20	14	19	9	13	46	52	33	18	5	6
Total	30	31	20	34	15	27	65	93	72	50	16	28
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Upper half	23	35	30	46	40	52	29	44	51	64	57	78
Lower half	77	65	70	54	60	48	71	56	49	36	43	22
Total	100	100	100	100	100	100	100	100	100	100	100	100
Coefficient of association	0.287		0.32		0.235		0.31		0.20		0.34	

who go on to colleges or other schools beyond high school have a very definite trend for the best students to leave the district, the coefficient of association being 0.34. Thus it may be safely concluded that those who drop out of high school (49 per cent of the total) and those who go on to college or other schools (14 per cent), have a definite tendency to leave the district if they are in the upper halves of their classes. It should be noted that these two classes form 63 per cent of the total sample, or nearly two-thirds. On the other hand, among those who complete high school and go no further, there is much less difference between the grades of those who remain in the district and those who leave it.

Thus the district appears to be losing slightly more of its more able youth, as measured by achievement in school, than it is keeping.

However, as it was interesting to speculate on the extent of future migration from this group, using the data on the older age groups as a basis for estimates, it is doubly interesting to make similar estimates, on the extent of selectivity on the basis of mental ability (as indicated by

TABLE 13. CLASS RANKS OF FORMER STUDENTS IN RELATION TO LOCATION WITHIN OR OUTSIDE THE DISTRICT, BY AGE GROUPS

Class ranks	Total	Present location		
		In the district	Outside the district	Away at school
Under 21:	*Number*	*Number*	*Number*	*Number*
Total	84	49	24	11
Upper half	38	23	7	8
Lower half	46	26	17	3
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Upper half	45	47	29	73
Lower half	55	53	71	27
Total or average	100	58	29	13
Upper half	100	61	18	21
Lower half	100	56	37	7
21–25:	*Number*	*Number*	*Number*	*Number*
Total	104	43	55	6
Upper half	58	21	31	6
Lower half	46	22	24	0
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Upper half	56	49	56	100
Lower half	44	51	44	0
Total or average	100	41	53	6
Upper half	100	36	54	10
Lower half	100	48	52	0
26 and over:	*Number*	*Number*	*Number*	*Number*
Total	143	64	79	0
Upper half	71	25	46	0
Lower half	72	39	33	0
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	0
Upper half	50	39	58	0
Lower half	50	61	42	0
Total or average	100	45	55	0
Upper half	100	35	65	0
Lower half	100	54	46	0

school grades) in the future migrations. It was found that for those now 26 years of age and over, 65 per cent of those who were in the upper halves of their classes when in school have migrated (table 13). On the other hand, only 46 per cent of the lower-half members of this age group have left.

It may be that this factor continues to increase in effect even after 26, and more than 65 per cent of the upper level of the group now 26 and over, which is actually a range of 26 to 38, may be migrants by the time they are 36 to 48 (ten years from now). Therefore, it may be that to make an estimate for the next ten years of the effect of the factor of ability as a selector of migrants, the proportion from the upper rank who will have migrated from the group now 26 to 30 should be increased. However, if it is assumed that the porportions will remain the same for the group now 26 and over, and that the younger group will be affected by the operation of this factor as the older has, it can be said that ten years hence, 65 per cent of those who were in the upper halves of their classes will have migrated, as compared with only 46 per cent of those from the lower halves. Stated conversely, only 35 per cent of the more able will still be in the district, and 54 per cent of the less able will still be there.

Location with reference to rural and urban areas

The data given above apply only to differences between those still resident in this school district and those who have moved from it. This study has not furnished data for testing the hypothesis that rural-urban migration results in a loss of the better elements in the rural population, because not all who have left the district have also left the farm or the rural areas. Comparison between the former students who are now resident in rural areas and those in cities is given in table 14.

TABLE 14. CLASS RANKS, BY FOURTHS, OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION IN RURAL OR URBAN AREAS

Rank in fourths of class	Total	Present location		
		In rural areas	In cities	In army or navy
	Number	*Number*	*Number*	*Number*
Total	320	253	62	5
1	84	64	19	1
1	80	59	20	1
3	81	62	17	2
4	75	68	6	1
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
1	27	25	31	*
2	25	23	32	*
3	25	25	27	*
4	23	27	10	*

*Numbers too small to figure percentages on them.

The most striking difference in proportions is in the lowest fourth. Twenty-seven per cent of those now in rural areas were in the lowest fourth while in school, but only ten per cent of those now in cities were from this level. There is a difference of only 5 per cent between the two groups in the proportions from the first fourth in favor of cities. It should

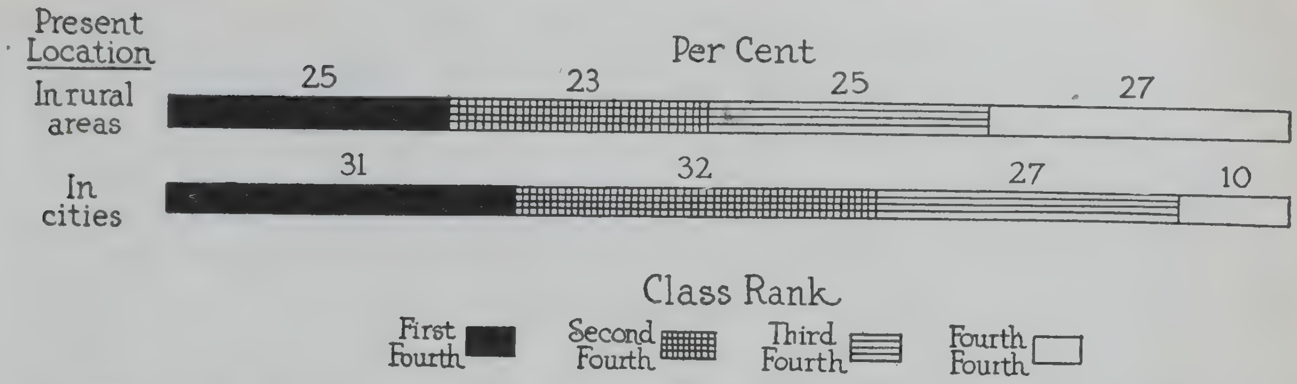

FIGURE 5. PERCENTAGE OF FORMER STUDENTS IN DIFFERENT CLASS RANKS, BY PRESENT PLACE OF RESIDENCE IN RURAL AREAS OR CITIES

be pointed out also that the group labeled "away at school" in the previous table has been included among the residents of rural areas in this table, tending therefore to raise the proportion from the upper levels.

There are apparently greater differences between those in rural areas and those in cities than between those who have left this school district and those still in it. This indicates that among those who are going out from the district an additional selective process is going on sorting out those who go to other rural areas. Taking the sample as a whole, other rural areas are getting only slightly more of the better students than are staying in the district itself, and the city is getting considerably more.

Location with reference to farm, village, and city

In discussing rural territory, farm, non-farm and village have been included therein. Does this classification obscure what is happening with regard to the farm population itself?

If the students classified as residing in rural areas are separated into the two classes (farm, and village and non-farm), the distributions shown in table 15 result. There are only nine non-farm residents in this group; that is, those living in the open-country but not on a farm.

TABLE 15. CLASS RANKS, BY FOURTHS, OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION ON FARMS, IN VILLAGES AND IN NON-FARM HOMES, OR IN URBAN AREAS

Rank in fourths of class	Total	Present location			
		On farms	In villages and non-farm homes	In cities	In army or navy
	Number	*Number*	*Number*	*Number*	*Number*
Total	320	139	114	62	5
1	84	31	33	19	1
2	80	34	25	20	1
3	81	33	29	17	2
4	75	41	27	6	1
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100
1	27	22	28	31	*
2	25	25	22	32	*
3	25	24	26	27	*
4	23	29	24	10	*

*Numbers too small to figure percentages on them.

It is seen that the farm residents include a larger proportion of former students who have not done so well in school than do the residents of the village or of the city. The smallest proportion of those on farms is from the top fourth, and the largest proportion, from the lowest fourth. The village has a larger proportion than the farm from the upper fourth. On the other hand the city has about the same proportions of all the fourths except the lowest, and its proportion of that fourth is only one-third of that for the farms. Of 100 who were in the first fourth, 31 are now in cities, but only 10 of 100 from the lowest fourth are in cities. On the other hand, 22 of 100 students of the top fourth are on farms and 29 of 100 from the lower fourth are on farms.

This completes the analysis of the relation of class rank in school to present place of residence. In summary these data show:

1. That the school district is losing slightly more of its more able students, as measured by school grades, than it is keeping. It is still retaining a large proportion of the able students, but a larger proportion of its less able.
2. When present place of residence is considered in terms of rural and urban differences, rank in school grades seems to be a significant factor. Here the greatest differences are found in the distribution of the lowest-ranking students. Though the lower-ranking students are moving out of this school district in nearly the same proportions as are the better students, they are not moving out of rural areas to the same extent that better students are. The selectivity appears to be of the less able by the rural areas, rather than of the more able by the city. The number of the more able who are away at school makes the distribution of these upper-fourth groups less clear than that of the lower groups.
3. The farm population, as compared with that of the village and the city, has somewhat fewer of the highest rank, and has somewhat more than the village and considerably more than the city of those from the lowest group.

YEARS OF SCHOOLING IN RELATION TO PRESENT PLACE OF RESIDENCE

One of the most widely-used measures for comparing migrants and nonmigrants is the number of years of schooling they have had.

For this group of former students, the number of years of schooling completed and the class rank achieved are closely related. This is similar to the finding mentioned previously that those who had spent fewer years at Union Academy tended to be in the lower fourths of their classes. This also checks with the numerous studies which show the selectivity of the school on the basis of scholastic ability. Fewer and fewer of those who make low scores on mental tests are found as one moves from elementary school to high school, and through high school to college. This states in another way the correlation between grades and intelligence, for some success in making grades is essential to remaining in school.

It is seen from table 16 that only nine per cent of those who do not finish high school are in the top fourth, but somewhat more than half of those who do not finish are in the bottom fourth, and three of four of them are in the lower half of their classes.

TABLE 16. SCHOOL RANKS OF FORMER STUDENTS IN RELATION TO SCHOOLING COMPLETED

Rank in fourths of class	Total	Schooling completed				
		Some high school	Four years of high school	Some college	College graduate	Trade school
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Total	337	104	167	35	18	13
1	91	9	45	20	12	5
2	86	16	56	9	3	2
3	80	25	46	4	0	5
4	80	54	20	2	3	1
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100	100
1	27	9	27	57	66	39
2	25	15	33	26	17	15
3	24	24	28	11	0	38
4	24	52	12	6	17	8

On the other hand, 83 per cent of those who graduate from college are from the upper half of their classes. There is a pronounced relation between the number of years spent in school and the grades received. At least this is true up to the completion of high school. But beyond that, economic factors probably also have their effect.

Four-fifths of these former students received no training beyond high school. Another ten per cent received some college training, but only five per cent graduated from college. The others went to trade school, which includes business college, short course in agriculture, or nurse's training. Most of those who went to college were in the top ranks in high school, but not all of them. In other words, high grades are not the only determinant of whether one goes to college; but without good grades there is even less likelihood.

The total students who had four years of high school or less, and those with more than a high-school education, were grouped into those in the upper and lower halves of their classes by rank (as given in table 16). This is shown in table 17.

TABLE 17. RELATION OF RANK IN CLASS TO AMOUNT OF SCHOOLING

Class rank	Attended high school only	College or trade school	Total
	Number	*Number*	*Number*
Upper half	126	51	177
Lower half	145	15	160
Total	271	66	337
	Per cent	*Per cent*	*Per cent*
Upper half	46	77	52
Lower half	54	23	48
Total	100	100	100

The coefficient of association between these two factors of rank and more than high-school training is +0.59, showing a high degree of association between them.

Because of this relationship between class rank and number of years of schooling completed, there is a possibility that similar qualities are measured in these two sections.

Before proceeding to a comparison of migrant with non-migrant on the basis of years of schooling, it should be pointed out that the data for this factor are available for a smaller number of students than in the case of the other factors already discussed. There is a tendency for those for whom these data are lacking to rank mostly in the lower fourths. It therefore follows that because of the relationship between class ranks and years of schooling discussed above, the cases for whom data are lacking have fewer years of schooling. Consequently the tables to follow may present a more favorable picture of the schooling of this group of former students than actually exists.

In table 18 it is shown that a larger proportion of those who left the community than of those who remained had training beyond high school. Nearly one-fourth of the group now out of the community have had training beyond high school, but only about one-eighth of those who are still there have had additional training.

TABLE 18. AMOUNT OF SCHOOLING OF FORMER STUDENTS IN RELATION TO PRESENT LOCATION WITHIN OR OUTSIDE THE SCHOOL DISTRICT

Amount of schooling	Total	Present location		Away at school
		Not in school		Parents in the district
		In the district	Outside the district	
	Number	*Number*	*Number*	*Number*
Total	302	148	137	17
Some high school	93	48	44	1
Four years high school	152	83	60	9
Some college or normal school	30	9	14	7
College or normal-school graduate	15	6	9	0
Trade school	12	2	10	0
	Distribution of present location by amount of schooling			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Some high school	31	32	32	6
Four years high school	50	57	44	53
Some college or normal school	10	6	10	41
College or normal-school graduate	5	4	7	0
Trade school	4	1	7	0
	Distribution of amount of schooling by present location			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	49	45	6
Some high school	100	52	47	1
Four years high school	100	54	40	6
Some college or normal school	100	30	47	23
College or normal-school graduate	100	40	60	0
Trade school	100	17	83	0

Of those who did not go beyond high school, 44 per cent are now outside the district, while 66 per cent of those who went beyond high school have

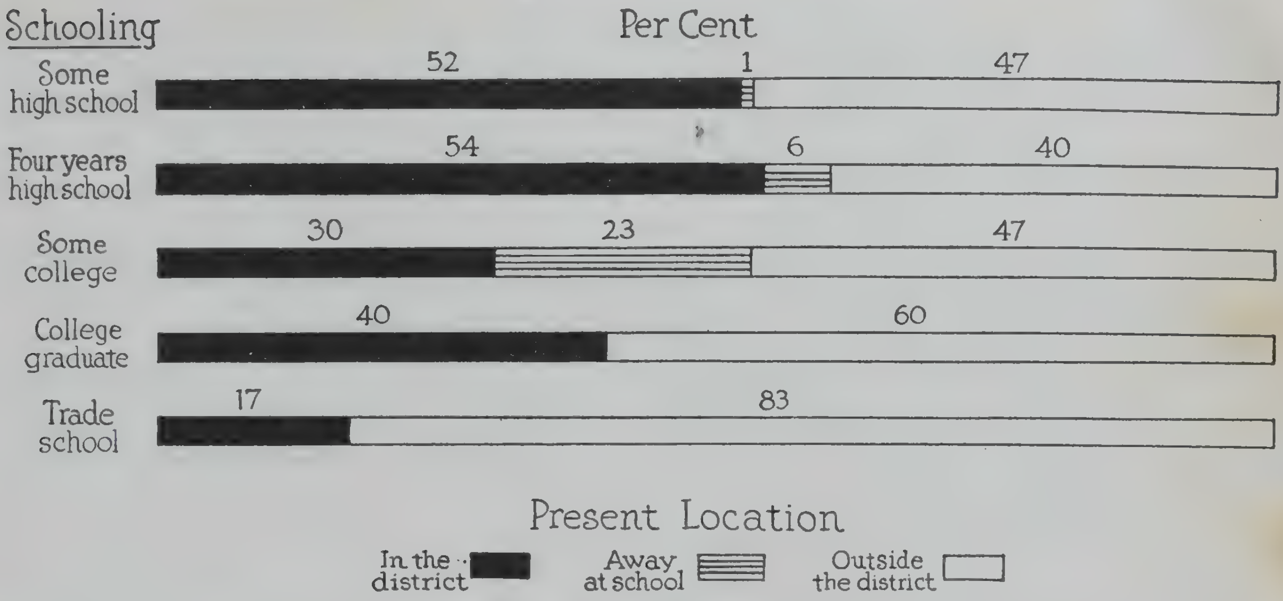

FIGURE 6. PERCENTAGE OF FORMER STUDENTS INSIDE OR OUTSIDE THE DISTRICT, BY AMOUNT OF SCHOOLING

moved from the district, as shown in table 19. The coefficient of association between the two factors of amount of schooling and present place of residence is +0.42, showing a considerable relationship.

TABLE 19. RELATION BETWEEN AMOUNT OF SCHOOLING AND PRESENT PLACE OF RESIDENCE*

Present place of residence	Attended high school only	College or trade school	Total
	Number	*Number*	*Number*
In the district	131	17	148
Outside the district	104	33	137
Total	235	50	285
	Per cent	*Per cent*	*Per cent*
In the district	56	34	52
Outside the district	44	66	48
Total	100	100	100

*Coefficient of association +0.419

Because of concern over the possible bias introduced by lack of information on some of the cases, estimates were computed for them on the basis of their class ranks; the proportion among the migrants of those with no training beyond high school was increased by three per cent. However, this still leaves a nine-per-cent difference between migrants and non-migrants in the proportions of those with advanced training.

About the same proportions of the two groups, those who have left and those still in the district, have not finished high school. If this were corrected on the basis of estimated distribution of those whose advanced schooling was unknown, the proportion of the migrants who had not finished high school would be increased by three per cent.

It appears that the group who have left represent greater extremes—more who have not finished high school and more who have gone on to college and other schools. The community may be slightly disadvantaged by having a smaller proportion of college-trained residents return to it than leave it permanently.

Only 12 per cent of those now in the community went away for additional schooling, but 24 per cent of those who are now resident elsewhere had additional schooling. If this same sample were studied ten years from now, the proportion with advanced training among those who had left the district would be even greater, for 70 per cent of those now away at school would also be gone. To send its sons and daughters on to school is a rather sure way for this community to lose them.

Turning next to the rural-urban comparisons (table 20), much greater differences are seen than in comparisons between those still in the district and those who have left it. This, it will be recalled, was also true in the analysis by class rank.

TABLE 20. YEARS OF SCHOOLING IN RELATION TO PRESENT LOCATION IN RURAL OR URBAN AREAS

Years of schooling	Total	Present location		
		In rural areas	In cities	In army or navy
	Number	*Number*	*Number*	*Number*
Total	294	232	53	9
Some high school	92	77	12	3
Four years high school	147	120	21	6
Some college or normal school	29	22	7	0
College or normal-school graduate	15	9	6	0
Trade school	11	4	7	0
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Some high school	31	33	23	33
Four years high school	50	51	40	67
Some college or normal school	10	10	13	0
College or normal-school graduate	5	4	11	0
Trade school	4	2	13	0

The proportion of those in rural areas who have not finished high school exceeds by 11 per cent the proportion of this class for those resident in cities. Furthermore 38 per cent of those former students who are now in cities have had training beyond high school, but only 15 per cent of those in rural areas have had such training.

It should also be pointed out that the students who are now away at school are included in the two groups *some college or normal school* and *trade school.* They are also included in *rural residents.* This tends to raise the level for the rural areas and for the district at this particular time, but, as pointed out earlier, the district will eventually lose a large number of them.

It was found in the analysis of the relation of present location and class-rank distribution that the differences between the farm and city were considerably greater than the differences between all rural and city. Likewise, when location and number of years of schooling are related, the differences between farm and city are marked (table 21). A larger proportion of those now on farms than of those in villages or cities have not completed high school. Twenty-four per cent more of those in cities than of those on farms have had training beyond high school.

TABLE 21. Years of Schooling of Former Students in Relation to Present Location on Farms, in Villages and in Non-farm Homes, or in Urban Areas

Years of schooling	Total	Present location			
		On farms	In villages and non-farm homes	In cities	In the army or navy
	Number	*Number*	*Number*	*Number*	*Number*
Total	294	127	105	53	9
Some high school	92	47	30	12	3
Four years high school	147	63	57	21	6
Some college or normal school	29	13	9	7	0
College or normal-school graduate	15	3	6	6	0
Trade school	11	1	3	7	0
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100
Some high school	31	37	29	23	33
Four years high school	50	49	53	40	67
Some college or normal school	10	10	9	13	
College or normal-school graduate	5	3	6	11	
Trade school	4	1	3	13	

It should be pointed out, too, that this group of students represents some selection on the basis of number of years of schooling since only those who finished at least one year of high school were included. All those who dropped out with less than that were eliminated because a satisfactory average grade could not be obtained for them.

One other aspect of analysis of present place of residence in relation to number of years of schooling remains—distance from high school attended. The question is, are those who have had more years of schooling farther removed from the district? Do the county and State, as well as the district, lose more of their better-educated young people than they keep? The answer is readily apparent in table 22. Again it should be mentioned that those away at college are classified as in the district. This tends to swell the proportion of those resident in the district who have had training beyond high school. It must be kept in mind this is not a permanent situation for this sample.

It will be recalled that the adjacent townships drew more of those who ranked in the lower fourths, and it is seen that they also have a larger proportion of those who have not completed high school than has any other area and they have a smaller proportion of those who have had training beyond high school.

The areas outside Jefferson County and the three adjacent counties get the best-educated of this group of former students. Thirty-eight per cent of those there have had training beyond high school. The area outside New York State also attracts a large proportion of the better-schooled, and a few of those who do not finish high school.

In summary of this section on the relationship between the number of school grades completed and present location it appears that years of schooling does not function as a selective factor in migration from this rural district until schooling beyond high school is considered.

It has been seen that about as many of those who moved from the district as of those who remained in it failed to finish high school. However, when considering movement from rural areas to cities, failure to finish high school

TABLE 22. AMOUNT OF SCHOOLING OF FORMER STUDENTS IN RELATION TO THE DISTANCE OF THEIR PRESENT LOCATION FROM THE DISTRICT

Amount of schooling	Total	Present location					
		In the school district	In adjacent townships	Elsewhere in Jefferson County	In adjacent counties	Elsewhere in New York State	Elsewhere in the United States
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Total	294	165	32	29	16	34	18
Some high school	92	49	15	8	6	9	5
Four years high school	147	92	14	13	8	12	8
Some college or normal school	29	16	1	4	0	7	1
College or normal-school graduate	15	6	0	0	2	3	4
Trade school	11	2	2	4	0	3	0
	Distribution of present location by amount of schooling						
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100	100	100
Some high school	31	30	47	28	38	26	28
Four years high school	49	55	44	44	50	35	44
Some college or normal school	10	10	3	14		21	6
College or normal-school graduate	6	4			12	9	22
Trade school	4	1	6	14		9	
	Distribution of amount of schooling by present location						
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	56	11	10	5	12	6
Some high school	100	53	16	9	7	10	5
Four years high school	100	63	10	9	5	8	5
Some college or normal school	100	56	3	14		24	3
College or normal-school graduate	100	40			13	20	27
Trade school	100	18	18	37		27	

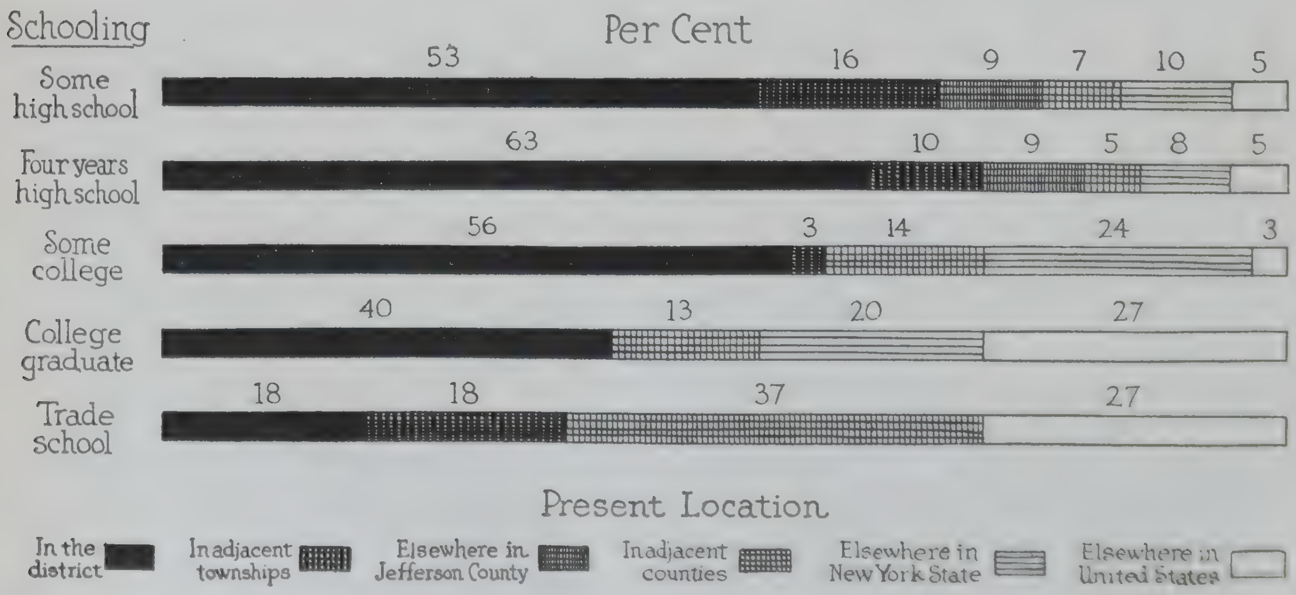

FIGURE 7. PERCENTAGE OF FORMER STUDENTS AT DIFFERENT DISTANCES FROM THE DISTRICT OF PRESENT PLACE OF RESIDENCE, BY AMOUNT OF SCHOOLING

and rural residence seem to be related. Slightly more of those now resident in rural areas (including farm and village residents) than in urban areas fail to finish high school. It cannot be said, however, that these students stay in rural areas because they failed to finish high school. It is possible that having decided to remain on a farm they felt further schooling unnecessary.

There is little doubt, however, that education beyond high school is related to movement from the district, from rural areas, and from the farm. The district has among its share of these students the smallest proportion of those with advanced training. The all-farm has a slightly larger proportion of those with further training—the all-rural a still larger proportion—, and the city much beyond the others. Though to some degree the difference between the district and the other areas may be attributed to the sample, there are still differences important enough to indicate the trend, with the city profiting from the higher education furnished by this community to its sons and daughters. But neither the district nor other rural areas are wholly without their college graduates.

FARM OR VILLAGE RESIDENCE WHILE ATTENDING HIGH SCHOOL, IN RELATION TO MIGRATION

Several studies which have included in their samples both farm and village residents have found the farm population to be less mobile than that of the village. It seemed worthwhile to compare the influence of farm residence at the time of attending high school with that of village and nonfarm residence in the case of this sample. One fact which does not encourage detailed analysis of this factor is the high proportion of these high-

TABLE 23. PLACE OF RESIDENCE OF FORMER STUDENTS WHILE ATTENDING HIGH SCHOOL, IN RELATION TO PRESENT LOCATION WITHIN OR OUTSIDE THE DISTRICT

Place of residence while attending high school	Total	Present location		
		Not in school		Away at school
		Residing in the district	Residing outside the district	Parents still in the district
	Number	*Number*	*Number*	*Number*
Total	333	155	162	16
Village or non-farm	70	24	38	8
Farm	263	131	124	8
	Distribution of present location by place of residence while in high school			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Village or non-farm	21	16	24	50
Farm	79	84	76	50
	Distribution of place of residence while in high school by present location			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	47	48	5
Village or non-farm	100	34	55	11
Farm	100	50	47	3

school students who were farm residents; 80 per cent of them came from farms, and only 20 per cent from village or non-farm homes.

Upon reference to table 23 it is seen that more of those who came from farm homes than of those from village homes remained in the district. Eighty-four per cent of the non-migrants are from farm homes but only seventy-six per cent of the migrants are from such homes.

Only thirty-four per cent of the village-reared students are still in the district, but almost half the farm-reared are still there.

Even though the farm-reared students do not move out of the district in quite such large proportions as do the village- or non-farm-reared, 47 per cent of them have left. Where do they go as compared with village-reared children? Do they go to farms or to cities? In table 24 it is shown that not so many farm-reared as village-reared individuals go into the urban areas. Thirty-six per cent of those now residing in urban areas are from village or non-farm homes, though the sons and daughters from these homes make up only twenty-one per cent of the total sample. Looking at the distribution of the two groups it is seen that the proportion of those who were reared in village and non-farm homes and are now living in cities is twice that of the proportion of farm-reared now living in cities.

TABLE 24. PLACE OF RESIDENCE OF FORMER STUDENTS WHILE ATTENDING HIGH SCHOOL, IN RELATION TO PRESENT LOCATION ON FARMS, IN VILLAGES AND IN NON-FARM HOMES, OR IN URBAN AREAS

Place of residence while attending high school	Total	On farms	In villages and rural non-farm homes	Total in rural areas	In cities	In the army and navy
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
Total	319	136	112	248	62	9
Village and non-farm	68	10	35	45	22	1
Farm	251	126	77	203	40	8
	Distribution of present location by place of residence in high school					
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100	100
Village and non-farm	21	7	31	18	36	11
Farm	79	93	69	82	64	89
	Distribution of place of residence in high school by present location					
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	43	35	78	19	3
Village and non-farm	100	15	51	66	32	2
Farm	100	50	31	81	16	3

If, as just shown, farm-reared individuals tend to remain in rural areas even though they may leave their school district, to what extent is this rural settlement limited to farms? By breaking up the group covered by the caption *in rural areas* into farm and village, the proportion of those reared on farms and still resident on farms can be ascertained.

Although 79 per cent of all the students were living on farms at the time they attended high school, only forty-three per cent of them are now resident there. The farms gained 8 per cent from the villages but sent 31 per cent of their boys and girls to the villages. Twenty-one per cent lived in a village or in non-farm residences when they were high-school students, but now thirty-five per cent are living there. The village and non-farm homes lost a small percentage to the farms and much more to the cities, but villages and rural non-farm residences, as a class, more than made up their losses through the movement of farm youth to them. The movement of farm youth from the farms to villages and rural non-farm homes was twice that of the movement to cities. The movement of village-reared youth to cities was twice that of the farm-reared youth to cities.

The proportion of the farm-reared women who are now in cities is almost twice the proportion of farm-reared men there.

TABLE 25. PLACE OF RESIDENCE WHILE ATTENDING HIGH SCHOOL IN RELATION TO PRESENT LOCATION ON FARMS, IN VILLAGES AND IN RURAL NON-FARM HOMES, OR IN URBAN AREAS, BY SEXES

Residence while attending high school	Total		Present location						
			On farms		In villages or rural non-farm homes		In cities		In army or navy
	Males	Females	Males	Females	Males	Females	Males	Females	Males
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Total	174	201	83	69	54	89	28	43	9
Village or non-farm	31	47	6	6	13	28	11	13	1
Farm	143	154	77	63	41	61	17	30	8
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	100	48	34	31	45	16	21	5
Village or non-farm	100	100	19	13	42	59	36	28	3
Farm	100	100	53	40	29	40	12	20	6

Women exceed farm-reared men in the villages almost as much as in the city. One and one-half times as many of the farm girls as farm men have moved to villages and to rural non-farm homes.

Forty-four per cent of the girls are now resident in villages although only twenty-three per cent of them lived in villages at the time they attended high school. Only thirty-four per cent of the girls now live on farms though 77 per cent of them lived on farms when they were in high school, a decrease of 43 per cent. Forty-eight per cent of the boys now live on farms, whereas eighty-two per cent lived on farms when attending high school, a decrease of thirty-four per cent.

A larger proportion of village-reared men than of village-reared women have made the move to the city, but more farm women than farm men have moved to the city. Village-reared women have stayed in the same type of area more than have any other group. Farm-reared women have changed type of area more than have any other group.

Smaller proportions of farm-reared youth than of village-reared have gone to the cities. Does it follow that they also move shorter distances? The data on this are given in table 26. Half as many of the farm-reared as of the village-reared youth are residing outside the State. Six per cent less of the farm-reared reside outside the county but within the State. A larger proportion of the farm-reared than of the village-reared are in the district and in the adjacent townships. A larger proportion of the village-reared are outside Jefferson County, and also a larger proportion outside New York State.

TABLE 26. PLACE OF RESIDENCE OF FORMER STUDENTS WHILE ATTENDING HIGH SCHOOL, IN RELATION TO DISTANCE OF THEIR PRESENT LOCATION FROM THE DISTRICT

Place of residence while attending high school	Total	Distance from district of present location					
		In school district	In adjacent townships	Elsewhere in Jefferson County	In adjacent counties	Elsewhere in New York State	Elsewhere in United States
	Number	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Total	320	171	37	35	18	41	18
Village and non-farm	69	32	6	8	3	13	7
Farm	251	139	31	27	15	28	11
	Distribution of place of residence in high school by present location						
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	2	12	11	6	13	6
Village and non-farm	100	46	9	12	4	19	10
Farm	100	56	12	11	6	11	4

In summary then, it appears that living either on a farm or in a village while attending high school is a factor related to the present place of residence.

1. There are fewer migrants among the farm-reared students than among the village- and non-farm-reared.
2. Those who come from farm homes are considerably more likely to be in rural areas than are those from village- or non-farm homes.
3. Five of ten farm-reared individuals are now living on farms; three of ten are in villages; not quite two of ten are in cities. The remainder are in either the army or the navy.
4. One of ten of the village- or non-farm-reared are on farms; five of ten are in village- and non-farm homes; and more than three of ten are in cities.
5. The proportion of the farm-reared women now in cities is nearly twice that of farm-reared men.
6. Those students who came from farm homes have not, on the average, migrated as great distances as have those reared in village homes. A proportionately smaller number are outside the State, outside the county, and outside the district.

FACTORS IN THE PARENTAL HOME IN RELATION TO PRESENT LOCATION OF FORMER STUDENTS

As various personal factors such as age, sex, and class rank were discussed in preceding sections, the possibility was suggested that certain factors in the parental home might also have had their effect upon the migration of these former students. Information on various factors in the parental home is available from a family schedule for 148 of these former students whose families were resident in the area covered by the field study. This is too small a sample for detailed analysis, but a few factors have been selected.

There is a pronounced difference between the proportion of migrants among the former students whose parents are residing in the area covered by the field study and the proportion among the whole group of one-time students. Only 37 per cent of the first group have left, but 48 per cent of the whole group are gone. It will be recalled that in referring to migrants only those were included who left the community independently of a parental move, so that in the case of those migrants whose parents are now gone from the community, the young people's move preceded that of the parents.

It should be pointed out that the area covered by the field study in which the parental-family schedules were obtained represents only that portion of the school district included in the village and within a three-mile radius of the village. Consequently, in comparing students whose parents are still in the community with the total group of students, those from a restricted area are compared with those from a larger area. This at least leaves open the possibility that the eleven-per-cent difference in migrants may be attributed in some degree to differences within the school district itself. And in view of the quality of the soil and the nature of the agriculture on the western and southern boundaries of the district this hypothesis does not seem untenable.

Number of moves made by head of parental household

Because information on present place of residence of the parents of all students is not available, movement of parents from the district and migration of the students cannot be analyzed for the whole sample. However, in the case of the area covered by the field study, information descriptive of the mobility patterns of the parental households is available. This is indicated by the number of moves which the household has made since its inception.

The number of times the family head has changed work place was used in order to cover the moves made from farm to farm. For the village households no change was recorded if the change of work place did not involve moving to another community.

The data showing the relationship between present location of the former students and the mobility of their parents are given in table 27. It is seen that there is a high degree of stability in the parental group. One-fourth of them have not changed work place since marriage; one-half have not made more than three moves.

There appears to be no clearly marked relationship between the migration patterns of the family and those of the son or daughter. A larger proportion (71 per cent) of the sons and daughters of those who have moved ten or more times than of the sons and daughters of those who have never moved (58 per cent) are still in the community.

The number of parental moves from zero to six seems to have little effect upon the proportion of sons and daughters still in the community. It is probable that the fluctuation in proportions in the last two classes is due purely to chance.

TABLE 27. MIGRATION OF FORMER STUDENTS IN RELATION TO NUMBER OF MOVES MADE BY HEAD OF PARENTAL HOUSEHOLD

Number of moves made by head of parental household since first marriage	Total	Present status in relation to community		
		Not in school		Away at school
		Residing in the district	Residing outside the district	
	Number	*Number*	*Number*	*Number*
Total	146	79	55	12
None	36	21	9	6
1–3	36	19	15	2
4–6	38	22	12	4
7–9	22	7	15	0
10 or more	14	10	4	0
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
None	25	27	16	50
1–3	25	24	27	17
4–6	25	27	22	33
7–9	15	9	26	0
10 or more	10	13	7	0

Consequently, there is no evidence in this sample that the number of moves of the parent is associated with movement of sons and daughters from the area of the parental home.

Migration of former students in relation to number of years head of parental household has lived in the community

One other way of measuring the family pattern of mobility is by number of years the head of the household has lived in this community. According to the data supplied by table 28, it is apparent that there is no relationship between the length of time the parent has been in the community and the

TABLE 28. MIGRATION OF FORMER STUDENTS IN RELATION TO NUMBER OF YEARS HEAD OF PARENTAL HOUSEHOLD HAS LIVED IN THE COMMUNITY

Number of years head of parental household has lived in community	Total	Present status in relation to community		
		Not in school		Away at school
		Residing in the district	Residing outside the district	
	Number	*Number*	*Number*	*Number*
Total	154	86	56	12
1–10	22	14	6	2
11–20	30	20	9	1
21–30	25	11	14	0
31–40	23	12	9	2
41–50	19	9	5	5
51 or more	35	20	13	2
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	56	36	8
1–10	100	64	27	9
11–20	100	67	30	3
21–30	100	44	56	0
31–40	100	52	39	9
41–50	100	48	26	26
51 or more	100	57	37	6

migration of his sons and daughters. Fewer of the sons and daughters from the group resident in the community 21 to 30 years than from any other group are still in the community. But this low point in the middle of the distribution can be accounted for only by chance factors.

Migration of former students in relation to occupation of head of parental household

It has already been pointed out to what a large extent this is a sample of farmers' sons and daughters. Since farming is an occupation which more than any other involves the whole family, it is to be expected that this parental occupation would affect the migration of the sons and daughters. In no other vocation is the occupation passed on from father to son to the extent that it is in farming. Because the home and the farm enterprise are part and parcel of each other, the boy's vocational training is acquired inevitably as a part of growing up. He is already trained for a vocation by the time he finishes high school; what is more natural than that he should remain in a field where he has already acquired some skill, particularly, if the opportunity is open to him to continue in the occupation through inheritance?

Data showing the relationship between the occupation of the family head and the migration of sons and daughters are given in table 29. It is seen that the farm owners' children are more likely to have remained in the community than those of any other occupational group, though the differences are not striking. Of the total group, 36 per cent have left, but only 33 per cent of the farm owners' sons and daughters. More likely to leave are the sons and daughters of the farm tenant, the farm laborer, or farm manager, for whom there is no prospect of inheriting the business. The number of children of farm owners is sufficient to analyze by sexes. It is found, as would be expected, that there is a tendency for more of the

TABLE 29. MIGRATION OF FORMER STUDENTS IN RELATION TO OCCUPATION OF HEAD OF PARENTAL HOUSEHOLD

Occupation of head of parental household	Total	Present status in relation to community: Not in school: Residing in the district	Present status in relation to community: Not in school: Residing outside the district	Present status in relation to community: Away at school
	Number	*Number*	*Number*	*Number*
Total	154	86	56	12
Farm owners	61	37	20	4
Farm tenants, managers, and laborers	34	17	16	1
All others	59	32	20	7
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Farm owners	40	43	36	33
Farm tenants, managers, and laborers	22	20	29	8
All others	38	37	35	59
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	56	36	8
Farm owners	100	60	33	7
Farm tenants, managers, and laborers	100	50	47	3
All others	100	54	34	12

sons than of the daughters to remain, 65 per cent as compared with 57 per cent. Only 27 per cent of the farm owners' sons who are no longer in school have left the district, but 37 per cent of the daughters.

The *all others* class covers the non-agricultural group ranging from the professions to the unskilled and unemployed, but there are so few in each occupation, it is useless to break it up.

The proportion of the sons and daughters from all other occupations remaining in the community is almost as large as that of farm owners and even more than that of farm tenants and laborers. This tendency for the sons and daughters of farmers to remain in the community is less than that noted in the section on the place-of-residence factor (table 23 and context) for the farm-reared to remain in the community as compared with those from village homes. Sixteen per cent more of the farm-reared than of the village-reared were still in the community in that case. Here about seven per cent more farm owners' sons and daughters are still in the community and four per cent fewer of the tenants' and farm laborers' sons and daughters are there, as compared with the sons and daughters of all other occupations.

An indirect approach to the problem of the relationship between migration and the parental home may be made by checking the parent household against two personal factors which in the previous analysis appeared to be related to mobility—number of years of schooling and rank in school.

It was found in the previous analysis that those former students who had had training beyond high school tended to leave the community in considerably greater proportions than did those with less schooling. Upon reference to table 30 it is seen that in this sample there appears to be some relation between the occupation of the father and years of schooling beyond high school. Though farm tenants' and farm laborers' sons and daughters make up only 23 per cent of the sample, they make up 29 per cent of those who did not finish high school. However, if they finish high school, the sons and daughters of tenants and farm laborers are almost as likely to go on to college as are the farm owners' sons and daughters, though less likely to finish. The sons and daughters of those in other than agricultural occupations are more likely to go to college or trade school and more likely to finish college.

This appears to introduce an inconsistency because those with more schooling leave the district, but not so many of the sons and daughters of those in other than agricultural occupations leave as of the sons and daughters of farm tenants who have had less schooling. One needs to know, therefore, which sons and daughters do leave in each occupational group, but the sample is too small to warrant sorting for this.

Rank in school work appeared to be related to migration to cities in the larger sample. In table 31 data are presented on the relationship of the father's occupation to the achievement in high school of his sons and daughters. First and second fourths have been combined into the upper half, and the third and fourth fourths into the lower half.

This section of the total sample tends to be a more able group with a preponderance from the upper halves of their classes. This may be significant for the community. It indicates one of two facts. Either the families covered by the area of the field study furnished a majority of the more

TABLE 30. SCHOOLING OF FORMER STUDENTS IN RELATION TO OCCUPATION OF HEAD OF PARENTAL HOUSEHOLD

Occupation of head of parental household	Total	Schooling of former students			
		Some high school	Four years of high school	Some college or normal school, trade school and nurse's training	College graduate
	Number	*Number*	*Number*	*Number*	*Number*
Total	151	48	70	23	10
Farm owner	59	17	31	7	4
Farm tenants, managers, and laborers	34	14	14	5	1
All others	58	17	25	11	5
	Distribution of amount of schooling by parents' occupation				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100
Farm owners	39	35	44	30	40
Farm tenants, managers, and laborers	23	29	20	22	10
All others	38	36	36	48	50
	Distribution of parents' occupation by amount of schooling of students				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	32	46	15	7
Farm owners	100	29	52	12	7
Farm tenants, managers, and laborers	100	41	41	15	3
All others	100	29	43	19	9

TABLE 31. RELATION BETWEEN CLASS RANK IN HIGH SCHOOL OF FORMER STUDENTS AND OCCUPATION OF HEAD OF PARENTAL HOUSEHOLD NOW IN THE COMMUNITY

Occupation of head of parental household	Total	Class rank of former students	
		Upper half	Lower half
	Number	*Number*	*Number*
Total	154	88	66
Farm owners	61	35	26
Farm tenants, managers, and laborers	34	17	17
All others	59	36	23
	Per cent	*Per cent*	*Per cent*
Total or average	100	57	43
Farm owners	100	57	43
Farm tenants, managers, and laborers	100	50	50
All others	100	61	39

able of the school district or those whose families have remained, as contrasted with those who have left, are the more able.

The agricultural occupations do not do quite so well as others in supplying upper-half students, though the difference between children of farm owners and those whose parents have other occupations, is not so great.

Fewer of the tenants' and farm laborers' children are in the upper half of their classes than of those from any other group.

This again presents an inconsistency because in the previous analysis those in the lower class ranks tended to remain in the community. Therefore, fewer of the children of farm tenants and laborers should be leaving the community, rather than more. However, it must be recalled that this covers only a comparatively small portion of the sample. Furthermore, a check of the tenants' and laborers' children might show that those who left were the most able of their group.

Migration of former students in relation to schooling of parents

One other factor in the parental home remains to be discussed in relation to the migration of the sons and daughters, and that is the schooling of the parent. Do the parents who themselves have had less schooling, and less knowledge of other vocations, and who possibly have fewer contacts outside the district, tend to keep their sons and daughters, largely because they cannot put them in touch with other opportunities?

It is found upon referring to table 32 that this appears true. A larger proportion of the sons and daughters of those who had less than eight years of schooling are still in the district. However, the high proportion of the sons and daughters away at school, of the parents who have had more education, makes the comparison difficult, because the proportion who have left the community and are now out of school is also smaller for the sons and daughters of those with more education. However, since most of those now away at school will not return to the community, it can be concluded that there is a greater migration of the sons and daughters of parents with more years of schooling.

TABLE 32. PRESENT LOCATION OF FORMER STUDENTS IN RELATION TO THE SCHOOLING OF THE HEAD OF THE PARENTAL HOUSEHOLD

Schooling of head of parental household	Total	Present status in relation to community		
		Not in school		Away at school
		Non-migrant	Migrant	
	Number	*Number*	*Number*	*Number*
Total	154	86	56	12
Less than eight grades	38	24	14	0
Eight grades	38	21	17	0
Some high school	45	25	16	4
Four years of high school	15	9	5	1
Some college	10	4	3	3
College graduate	8	3	1	4
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	56	36	8
Less than eight grades	100	63	37	0
Eight grades	100	55	45	0
Some high school	100	55	36	9
Four years of high school	100	60	33	7
Some college	100	40	30	30
College graduate	100	38	12	50

In summary, the mobility patterns of the parental household seem to bear no relation to the migrations of sons and daughters. There is a very slight relationship between occupation of parental head and migration of sons and daughters, and between schooling of parental head and migration of sons and daughters.

The numbers are small and what may be taken for relationships may be only chance differences.

OCCUPATIONAL DISTRIBUTION OF FORMER STUDENTS

Movement from one type of work to another involves quite as much adjustment for the individual as does movement from one community to another. To what extent have vocational adjustments also been involved in the mobility of these former students? To what extent have they continued in the occupation which many of them learned as they grew up—farming? This rural community has been proud of the contributions made by its sons and daughters who have left it during the past century, as described in Miss Hoag's bulletin.[13] Is this community continuing to make a contribution to the nation through its sons and daughters? It is to answer these questions as well as to supplement the analysis of spatial mobility, that analysis of occupations of this group of former students is given here.

IN RELATION TO PRESENT LOCATION

In tables 33 and 34 are given data on the occupational distribution of these students in relation to their present place of residence.[14] Almost half the boys are now in agricultural pursuits. Seventeen per cent are farm owners, tenants, or managers; eighteen per cent are farm laborers; and thirteen per cent are working at home on their father's farms. An even higher proportion in agriculture might have been expected in view of the fact that more than three-fourths of these former students resided on farms when they were attending high school.

What occupations other than farming are open to these sons of farmers and villagers? The age of this group must be kept in mind as the occupational factor is analyzed, since a large proportion of them have only recently finished school and have not yet established themselves occupationally.

As yet only five per cent of them are in the professions, but this proportion is certain to be augmented by those who are now in college (table 33). *All others* includes proprietors, managers, skilled workers, semi-skilled, clerical, and unskilled; none of the numbers in these individual classes were large enough to warrant computing percentage on them. These former students have an unusually small number of unemployed among them, as compared with the proportion of unemployed in the total population, or compared with the unemployed among samples covered by youth studies. Some of those who are now classified as working at home might be in the unemployed group had they given the information themselves. This applies in a few cases where the former student is resident in a home covered by the field schedule, and the data were obtained from the parent who might be less inclined to class his son as unemployed than the boy would be. Dickens, in her study, found in comparing parents' answers

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[13] See footnote 4, page 4.

[14] These tables include all of the former students for whom data on occupations were obtained; that is, 362 out of the total group of 408, or 88 per cent. Information was obtained for 92 per cent of the girls and 85 per cent of the boys.

TABLE 33. PRESENT OCCUPATIONS OF FORMER MALE STUDENTS IN RELATION TO PRESENT LOCATIONS WITHIN OR OUTSIDE THE DISTRICT

Present occupation	Total	Present locations		
		Not in school		Away at school
		In the district	Outside the district	Parents in the district
	Number	*Number*	*Number*	*Number*
Total	160	77	75	8
Student	8	0	0	8
Professions	8	2	6	0
Farm operators and managers	27	18	9	0
Farm laborers	29	16	13	0
Working at home	21	19	2	0
All others (non-agricultural)	63	19	44	0
Unemployed	4	3	1	0
	Distribution of present locations by occupations			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Student	5	0	0	100
Professions	5	3	8	
Farm operators and managers	17	23	12	
Farm laborers	18	21	17	
Working at home	13	24	3	
All others (non-agricultural)	39	25	59	
Unemployed	3	4	1	
	Distribution of present occupations by present locations			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	48	47	5
Student	100	0	0	100
Professions	100	25	75	
Farm operators and managers	100	67	33	
Farm laborers	100	55	45	
Working at home	100	90	10	
All others (non-agricultural)	100	30	70	
Unemployed	100	75	25	

with children's answers to questions about the children that there was a tendency for the parent to view the child's residence in the home differently from the son or daughter.[15]

So far as the girls are concerned their singleness of occupation is determined by their sex. More than 50 per cent of them are housewives in their own homes; ten per cent are engaged in housework; and fifteen per cent more are working in the parental home. Thus, three-fourths of them are in domestic occupations. Only eight of a hundred get into professional work, somewhat more than the boys. However, professional ratings for women are attained with shorter training than for men. Nursing and teaching are the professions followed by the girls.

Clerical work does not furnish occupations for as many as might be expected, only eight of a hundred. A slightly larger proportion of the girls than of the boys reported themselves unemployed, possibly because housework occupies them less than farming occupies the boys.

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[15] Dickens, Dorothy. Occupations of sons and daughters of Mississippi cotton farmers. Mississippi State College Agr. Exp. Sta. Bul. 318. 1937.

TABLE 34. PRESENT OCCUPATIONS OF FORMER FEMALE STUDENTS IN RELATION TO PRESENT LOCATIONS WITHIN OR OUTSIDE THE SCHOOL DISTRICT

Present occupation	Total	Present locations		
		Not in school		Away at school
		In the district	Outside the district	Parents in the district
	Number	*Number*	*Number*	*Number*
Total	200	79	112	9
Student	9	0	0	9
Professional	15	0	15	0
Clerical and semi-skilled	16	8	8	0
Working at home	31	22	9	0
Housewife	102	34	68	0
Housework and other unskilled	20	10	10	0
Unemployed and incapacitated	7	5	2	0
	Distribution of present locations by present occupations			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100
Student	5			100
Professional	8		13	
Clerical and semi-skilled	8	10	7	
Working at home	15	28	8	
Housewife	50	43	61	
Housework and other unskilled	10	13	9	
Unemployed and incapacitated	4	6	2	
	Distribution of present occupations by present locations			
	Per cent	*Per cent*	*Per cent*	*Per cent*
Total or average	100	40	56	4
Student	100			100
Professional	100		100	
Clerical and semi-skilled	100	50	50	
Working at home	100	71	29	
Housewife	100	33	67	
Housework and other unskilled	100	50	50	
Unemployed and incapacitated	100	71	29	

This study serves to emphasize the importance of the training for homemaking for high-school girls, since that is the occupation to which most of them give the majority of their years. Many have two vocations to prepare for: the one which is followed for a few years preceding marriage, such as teaching, stenography, nursing; and that which they will follow most of their lives, homemaking.

So far as the relation between occupation and place of residence is concerned, it is necessary to keep in mind the preponderance of younger people in the district, which affects the differences in occupational distribution of those in the district as compared with those who have left. It is pointed out in the analysis of factors affecting migration that age is important and that as these students grow older they will move out of the district in larger proportions, and with migration will come change in occupation. One source of considerable difference between those still in the district and those who have migrated is the class *working at home.* This undoubtedly is a temporary condition for a large number of both sexes, but particularly for the boys. Twenty-five per cent of the males still in the community are in this class, but only three per cent of those who are gone.

The greatest difference between the residents in the district and those who have left is in the non-agricultural occupations. About one-fourth of those who are still in the district are in skilled, semi-skilled, unskilled, and clerical occupations, but fifty-nine per cent of those who are gone from the district are in such occupations.[16]

It follows from this fact that a smaller proportion of those who have left the district are in agricultural occupations. There are only about half as many farm operators among those who have left the community as among those who are still there.

For the women there seems to be a good deal of difference in occupational proportions between those still in the district and those who have migrated. Only those who have left are in professional occupations. Those who have left are more likely to be married, a fact which follows from the differences in age distribution as is brought out later. They are less likely to be doing housework or other unskilled work, which in the community is usually waiting on table in a restaurant or resort. Even more of the girls than the boys who are still in the district are working at home, and there is a difference of twenty per cent between the proportions of the girls still in the district and those who have left in this occupational group.

As with the men, the differences in proportions between the two residential groups may be due in large part to the fact that the group still in the district is the younger.

IN RELATION TO AGE

Data on the relationship of age to occupation for this particular sample are given in tables 35 and 36. These tables show interesting changes in proportions in the various occupational groups as one follows across from age group to age group. As might be expected, there is a steadily increasing proportion of farm operators, and a decreasing proportion of farm laborers. The range in farm operators is from three per cent in the group under 21, to 30 per cent in the group over 30. Thirty-three per cent of the group under 21 are farm laborers, but this occupation accounts for only four per cent of the group over 30. It is interesting to observe the sharp decrease (20 per cent) in the proportion of those working at home when the group under 21 is compared with the next age group, 21 to 25. After that change the proportion remains almost the same for the other age groups. A concomitant of this fact is the pronounced increase in the proportion in non-agricultural occupations when comparison is made between the group under 21 and the one next above, 21 to 25. Twenty-six per cent more of the group 21 to 25 are in non-agricultural occupations than of the group under 21. In the group over 25 more than half are in non-agricultural occupations.

In the case of the female distribution similar significant changes in proportions are found as younger groups are compared with older. There is a similar decrease in the proportion working at home, though this is not so uniform as for the males. Most significant is the steady increase with increase in age in the proportion who are housewives in their own homes.

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[16] A large number of those in this group who are still in the district are truck and bus drivers.

TABLE 35. PRESENT OCCUPATIONS OF FORMER MALE STUDENTS IN RELATION TO AGE

Present occupation	Total	Present age in years			
		Under 21	21–25	26–30	Over 30
	Number	*Number*	*Number*	*Number*	*Number*
Total	155	33	51	48	23
Student	9	6	3	0	0
Professions	8	0	2	3	3
Farm operators and managers	27	1	6	13	7
Farm laborers	28	11	12	4	1
Working at home	21	10	5	4	2
Unemployed	4	0	2	2	0
Other unskilled and all other (non-agricultural)	58	5	21	22	10
	Distribution of age classes by occupations				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100
Student	6	18	6		
Professions	5		4	6	13
Farm operators and managers	17	3	12	27	30
Farm laborers	18		24	8	4
Working at home	14	34	10	8	9
Unemployed	3	30	4	4	
Other unskilled and all other (non-agricultural)	37	15	40	47	44
	Distribution of occupations by age classes				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	21	33	31	15
Student	100	67	33		
Professions	100		25	37	38
Farm operators and managers	100	4	22	48	26
Farm laborers	100	39	43	14	4
Working at home	100	47	24	19	10
Unemployed	100		*	*	
Other unskilled and all other (non-agricultural)	100	9	36	38	17

*Numbers too small to figure percentages on them.

From the first to the second group the proportion doubles. At 25, more than half are housewives. In the next group, 26 to 30, about ten per cent more find employment in this occupation, and in the group over 30, another twelve per cent are so classified. Not quite three-fourths of those in this oldest group are housewives.[17]

It is interesting to note the increase in the proportions in the professions from age group to age group, from two per cent in the youngest group to 13 per cent in the oldest. The sample is too small to warrant emphasizing these proportions but there is a possibility that age is not the only factor in this increasing proportion in the professions. It may be that opportunities for professional training are not open to the more recent students as they were earlier. Furthermore the earlier classes were more selective. A smaller number entered high school, and a larger proportion were of professional caliber. Entrance into the teaching profession has become increasingly difficult as longer terms of training are required. These hypotheses could be tested only by a larger sample.

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[17] It is to be noted that this is not the same as married, since this is an occupational classification, and if married women hold positions outside the home they are classified according to that occupation.

TABLE 36. PRESENT OCCUPATIONS OF FORMER FEMALE STUDENTS IN RELATION TO AGE

Present occupation	Total	Present age in years			
		Under 21	21–25	26–30	Over 30
	Number	*Number*	*Number*	*Number*	*Number*
Total	194	56	59	49	30
Student	10	6	4	0	0
Professions	14	1	4	5	4
Clerical and semi-skilled	15	5	6	2	2
Working at home	29	17	4	6	2
Housewife	99	15	32	30	22
Housework and other unskilled	20	8	6	6	0
Unemployed	7	4	3	0	0
	Distribution of age classes by occupations				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total	100	100	100	100	100
Student	5	11	7		
Professions	7	2	7	10	13
Clerical and semi-skilled	8	9	10	4	7
Working at home	15	30	7	12	7
Housewife	51	27	54	62	73
Housework and other unskilled	10	14	10	12	
Unemployed	4	7	5		
	Distribution of occupations by age classes				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Total or average	100	29	30	25	16
Student	100	60	40		
Professions	100	7	29	35	29
Clerical and semi-skilled	100	33	41	13	13
Working at home	100	58	14	21	7
Housewife	100	15	33	30	22
Housework and other unskilled	100	40	30	30	
Unemployed	100	*	*		

*Numbers too small to figure percentages on them.

The conclusion to be drawn from tables 35 and 36 is that, even in this narrow range, age and occupation are related for both sexes. For the men, the shift from agricultural to non-agricultural occupations is not great after 25 years of age. For the woman, the change is largely from the status of helpers in the parents' homes to homemakers in their own. The greatest change for them comes in the years from 21 to 25.

IN RELATION TO CLASS RANK

In tables 37 and 38 the former students are grouped according to their rank in the upper and lower halves of their classes. The distribution of the upper- and lower-half groups in the various occupations is difficult to analyze because more of the boys are in the lower halves of their classes, in high school. Therefore when males are analyzed separately, it is found that only two-fifths of them are from the upper halves of their classes. Therefore comparison between occupations by the proportion contributed to each occupation by the upper and lower halves of the classes seems most desirable. It is seen that the greatest difference between the upper and lower halves is in the professions.

TABLE 37. PRESENT OCCUPATION OF FORMER MALE STUDENTS IN RELATION TO CLASS RANK WHILE IN HIGH SCHOOL

Present occupation	Class rank		
	Total	Upper half of class	Lower half of class
	Number	*Number*	*Number*
Total	161	65	96
Student	9	5	4
Professions	8	7	1
Farm operators and managers	27	9	18
Farm laborers	29	9	20
Working at home	21	11	10
Unemployed	4	1	3
Other unskilled and all other (non-agricultural)	63	23	40
	Distribution of class ranks by present occupation		
	Per cent	*Per cent*	*Per cent*
Total	100	100	100
Student	6	8	4
Professions	5	11	1
Farm operators and managers	17	14	19
Farm laborers	18	14	21
Working at home	13	17	10
Unemployed	3	2	3
Other unskilled and all other (non-agricultural)	38	34	42
	Distribution of present occupation by class ranks		
	Per cent	*Per cent*	*Per cent*
Total or average	100	40	60
Student	100	56	44
Professions	100	88	12
Farm operators and managers	100	33	67
Farm laborers	100	31	69
Working at home	100	52	48
Unemployed	100	25	75
Other unskilled and all other (non-agricultural)	100	37	63

Though only forty per cent of all males come from the upper halves of their classes, eighty-eight per cent of those in the professions come from the upper group. Though the numbers are small this difference is large enough to be significant. Only 33 per cent of the farm operators and 31 per cent of the farm laborers are from the upper group. These are small differences but they are consistent with the trends pointed out in the previous section on class ranks. All other non-agricultural occupations have only a few more of the upper group than have the agricultural.

It is expected that the proportions of the female students from the upper and lower halves of their classes would be the reverse of the proportions for the male students. Fifty-nine per cent of the girls were in the upper ranks of their classes. In this case the greatest difference between occupations is in the student group. One hundred per cent of them are from the upper half.

The same difference in the professions is to be noted here also. Eighty-eight per cent of the women in professions ranked in the upper half of their classes. The clerical and semi-skilled occupations get a slightly larger proportion than their expected share of upper-half students. Unlike the boys who are working at home, the girls in this group seem to be

TABLE 38. PRESENT OCCUPATIONS OF FORMER FEMALE STUDENTS IN RELATION TO CLASS RANKS WHILE IN HIGH SCHOOL

Present occupation	Total	Class rank	
		Upper half of class	Lower half of class
	Number	*Number*	*Number*
Total	201	118	83
Student	10	10	0
Professions	15	13	2
Clerical and semi-skilled	16	11	5
Working at home	31	15	16
Housewife	102	56	46
Housework and other unskilled	20	8	12
Unemployed	7	5	2
	Distribution of class ranks by present occupations		
	Per cent	*Per cent*	*Per cent*
Total	100	100	100
Student	5	9	
Professions	8	11	2
Clerical and semi-skilled	8	9	6
Working at home	15	13	19
Housewife	50	47	56
Housework and other unskilled	10	7	15
Unemployed	4	4	2
	Distribution of present occupations by class ranks		
	Per cent	*Per cent*	*Per cent*
Total or average	100	59	41
Student	100	100	
Professions	100	87	13
Clerical and semi-skilled	100	69	31
Working at home	100	48	52
Housewife	100	55	45
Housework and other unskilled	100	40	60
Unemployed	100	71	29

less able scholastically. The proportion from the upper half among the housewives is slightly less than the proportion in the whole sample from the upper half. Still less of the upper-half members make up the group doing housework or other unskilled work.

It appears, therefore, that to a limited extent occupation and achievement in school are related. Only the more able academically got into the professional group or have gone on to schools and colleges in preparation for entering the professions. There appears to be some tendency for those who were more able scholastically to leave farming. Slightly less of the more able among the girls are in domestic occupations, including homemaking. As pointed out in the discussion under age distribution many of those who are still at home will be placed occupationally in a few years. A follow-up on the group five or ten years hence would give more complete information on the relationship of scholastic rank to occupation since the present occupations are by no means permanent.

IN RELATION TO PLACE OF RESIDENCE WHILE ATTENDING HIGH SCHOOL

It has been suggested that not all those living on farms are in farming as an occupation. Therefore, a check on the relationship of place of residence while in school to present occupation offers some refinement on the previous analysis of the factor of place of residence while in school.

The data on occupation and place of residence while in high school are given in tables 39 and 40. Eighty-two per cent of the males came from farms and this preponderance must be kept in mind in analyzing the table. The farm-reared males do not contribute to the professions to the extent that the village-reared do. Only two per cent of the farm-reared are in professions, as compared with 14 per cent of the village-reared. Nor are the farm-reared preparing for professions to the extent that the village-reared are, as indicated by those away at school. As would be expected, few village- or non-farm-reared have become farm operators, though 14 per cent of them are farm laborers. These may be the farm laborers who as they grow older get into the non-agricultural occupations.

TABLE 39. PRESENT OCCUPATIONS OF FORMER MALE STUDENTS IN RELATION TO PLACE OF RESIDENCE WHILE ATTENDING HIGH SCHOOL

Present occupation	Total	Place of residence while in school	
		Village or non-farm home	Farm
	Number	*Number*	*Number*
Total	158	28	130
Student	8	3	5
Professions	7	4	3
Farm operators and managers	27	1	26
Farm laborers	29	4	25
Working at home	21	0	21
Unemployed	4	0	4
Other unskilled and all other (non-agricultural)	62	16	46
	Distribution of place of residence while in high school by present occupations		
	Per cent	*Per cent*	*Per cent*
Total	100	100	100
Student	5	11	4
Professions	4	14	2
Farm operators and managers	17	4	20
Farm laborers	18	14	19
Working at home	13		16
Unemployed	3		3
Other unskilled and all other (non-agricultural)	40	57	36
	Distribution of present occupations by place of residence while in high school		
	Per cent	*Per cent*	*Per cent*
Total or average	100	18	82
Student	100	38	62
Professions	100	57	43
Farm operators and managers	100	4	96
Farm laborers	100	14	86
Working at home	100		100
Unemployed	100		100
Other unskilled and all other (non-agricultural)	100	26	74

The difference in proportions of village-reared and farm-reared making up the girls' sample is not quite so great but the farm-reared girls outnumber the village-reared three to one. A larger proportion of the village-reared are going away to school, but a slightly larger proportion of the

TABLE 40. PRESENT OCCUPATIONS OF FORMER FEMALE STUDENTS IN RELATION TO PLACE OF RESIDENCE WHILE ATTENDING HIGH SCHOOL

Present occupation	Total	Place of residence while in school	
		Village or non-farm home	Farm
	Number	*Number*	*Number*
Total	198	47	151
Student	10	5	5
Professions	14	3	11
Clerical and semi-skilled	16	3	13
Working at home	31	7	24
Housewife	100	21	79
Housework and other unskilled	20	7	13
Unemployed	7	1	6
	Distribution of place of residence while in high school by present occupations		
	Per cent	*Per cent*	*Per cent*
Total	100	100	100
Student	5	11	3
Professions	7	6	7
Clerical and semi-skilled	8	6	9
Working at home	16	15	16
Housewife	50	45	52
Housework and other unskilled	10	15	9
Unemployed	4	2	4
	Distribution of present occupations by place of residence while in high school		
	Per cent	*Per cent*	*Per cent*
Total or average	100	24	76
Student	100	50	50
Professions	100	21	79
Clerical and semi-skilled	100	19	81
Working at home	100	23	77
Housewife	100	21	79
Housework and other unskilled	100	35	65
Unemployed	100	14	86

farm-reared are already in professions. A substantially larger proportion of the farm-reared are married. A larger proportion of village and non-farm girls are doing housework, or acting as nursemaids or waitresses.

Place of residence while attending high school seems to be more closely related to professional and agricultural occupations than to others. It is more closely related to occupation in the case of the boys than in the case of the girls.

SUMMARY

It appears that of the factors studied age is probably more closely related to present occupation than to any other, at least until the age of 25 is reached. After that changes in proportions are small between age groups.

Scholastic achievement is related to occupation only when professions are considered. If the sample were larger and the *all other* non-agricultural occupations could be broken down, greater relationship might be found.

Place of residence while attending high school is related to farming and the professions. The other occupations attract about equal proportions of farm-reared and of village-reared individuals.

SUMMARY AND CONCLUSIONS

This bulletin states the findings regarding migration and the factors associated with it for 339 former students enrolled in Belleville Union Academy between the years 1919 and 1938. Forty-nine per cent of them have taken up residence outside the district and another five per cent are attending school outside the district. Almost one-fifth of the whole group are now city dwellers, and almost forty per cent of the migrants moved to cities.

Age data show that the proportion who have left the community has increased with age. Fifty-four per cent of those 21 years of age and over have migrated, as compared with 49 per cent for the whole group. The proportion of migrants in cities has also increased with age. Twenty-three per cent of those 21 years of age and over are in cities, as compared with only 6 per cent of those under 21.

More women than men have left the area and a larger proportion of the female migrants than of the male migrants went to cities.

Fifty-two per cent of the migrants and 44 per cent of the non-migrants came from the upper halves of their classes. Or stated another way, 41 per cent of the scholastically more able group remained in the district and 51 per cent migrated. The balance are away at school. Fifty-three per cent of those on farms, 49 per cent of those in villages, and 37 per cent of those in cities were from the lower halves of their classes.

Forty-seven per cent of all the former students now on farms, 51 per cent of those in villages, and 63 per cent of those in cities were in the upper halves of their classes when in high school.

If the selective process which has affected the migrations of the older members of the group continues to operate in the same way upon the younger members, the selection of migrants on the basis of scholastic ability will eventually be much greater for this group. Estimates made on the basis of the data for the oldest members of the group suggested that ten years hence at least 65 per cent of all those who were in the upper halves of their classes when in high school will have migrated, but only 46 per cent of those from the lower halves will have left. Stated conversely only 35 per cent of the better students will be in the district and 54 per cent of the less able will be there. From the point of view of the population of the community it was estimated that of those who will still be in the community ten years from now, 39 per cent will be from the upper scholastic group and 61 per cent from the lower.

Twelve per cent more of those who have left than of those who remained had training beyond high school. Twenty-four per cent more of those now in cities than of those in rural areas had training beyond high school.

Seven per cent more of the village-reared than of the farm-reared students have left the district. The proportion of village-reared in cities is twice that of farm-reared.

Half the men were in agriculture. Three-fourths of the women were in domestic occupations, including homemaking in their own homes. The men who remained in the community remained to follow agricultural pursuits to a large extent. Sixty-eight per cent of those who left went into non-agricultural occupations. The occupations of fathers and sons were closely related in the case of the agricultural occupations.

Selection of migrants is taking place on the basis of age, sex, ability as measured by grades obtained in high-school work, on years of schooling, and on the basis of place of residence while attending high school; that is, in farm or village homes. More pronounced is the effect of these factors in selecting out the migrants to the cities.

The nature of these selective factors suggests that migration is dependent upon the need to find the vocational opportunity which is lacking in the community or to find greater opportunity than it offers to those whose achievements in high school may indicate greater ability.

Conclusions regarding the seriousness of the selectivity on the basis of ability as measured by school grades depend upon acceptance of the estimates made regarding the probable future situation, and upon the degree to which scholastic ability is accepted as an index of mental ability, as pointed out on page 17. Assuming their acceptance, the seriousness of the selectivity of this factor is evident.

If the population in the community in the most productive years of life is composed of more and less scholastically able in a proportion of 2 to 3, it must follow that the community will have a different character than if it had kept a larger proportion of its more able. If it is composed of larger proportions of those with fewer years of schooling, it must be disadvantaged in its competition with urban communities. It must eventually accept leadership from those communities to which it has sent the larger proportion of its better educated and more able young people. It seems reasonable to conclude that some of the lack of interest in community activities and institutions and the disintegration of community solidarity might be accounted for by the selective character of migration from the community.

The implications of this study must necessarily be circumscribed since the area covered is not necessarily a representative sample of either rural New York or rural America. These conclusions and implications apply only to this community, though this study, in combination with other studies of similar findings and covering a representative sampling of rural areas, may eventually be used for generalizations of wider application.

This community does not represent a case of over-migration, the problem with which such writers as Miss Hoag were concerned 19 years ago, but instead a problem of selectivity. There is probably no more migration out of the community than is desirable in view of the decreasing need for workers in agriculture and in occupations requiring training. In fact the writer was impressed with what seemed a wholesome condition so far as employment of young people in the community is concerned, and it is well that so many have been able to find opportunity elsewhere.

It is desirable that a substantial proportion of the young people leave, but it is undesirable from the point of view of the community that the group who leave continue to carry with them the larger part of the more able and better educated. How may this difficulty be met? It was Miss Hoag's suggestion that strong institutions would make the community attractive to its young people.

> The universal cry of "keep the boy on the farm" can be expanded into a great public sentiment for establishing at the very door of the farms the institutions which all people crave. Neither exhortation nor force will keep people on farms, away from the best of the life of the world; but when the tide of the world flows up into the

> country and deposits its riches of thought on the institutional threshold of farm life, the great social motive of youth and middle age for leaving the farms will be undermined . . . . The weak, helpless cry of "keep the boy on the farm" can be transformed into a rallying cry: "Build great community institutions for farm boys and girls."[18]

One wonders, however, if the institution of the school at least did not open the way for greater opportunities to achieve social and economic status elsewhere.

It is believed that the conclusions regarding the reasons for migration imply clearly the problem before this and all other rural communities in which selective migration is taking place—to offer opportunities to their more scholastically able young people to win satisfactions equivalent to those which the same effort applied elsewhere would win for them. Those whose standards have been raised by life at college or other schools outside the community those who have been assured of their abilities through success in school are the more likely to go where sufficient return for their efforts can be obtained.

This problem is rooted in the difficulties of agriculture at the present time, and so far as the findings of this study are verified by studies of other rural areas, it furnishes support for any state or nation-wide efforts to decrease the differential in income and status between agriculture and other occupations.

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[18] See footnote 4, page 4. (Reference cited above is on page 53.)

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Bulletin 737

June 1940

Some Facts Concerning Country Fruit and Vegetable Auctions in Eastern Seaboard States

Edwin W. Cake

FIRST COUNTRY FRUIT AND VEGETABLE AUCTION ESTABLISHED IN NORTHEAST, RIVERHEAD, LONG ISLAND, NEW YORK

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SUMMARY AND CONCLUSIONS

Data were obtained from 64 country fruit and vegetable auctions located in 10 Eastern Seaboard States (Massachusetts to Florida), and from 431 growers and 114 buyers who patronized these auctions. Twenty-seven of the auctions were cooperative and 37 private or municipal auctions. During 1936, 48 vegetables, 18 fruits, and 4 other commodities were sold through these auctions.

The growth of country fruit and vegetable auctions seems to have been encouraged by (1) the increased use of motor trucks; (2) surpluses of products available at country shipping points together with general increases in the production of truck crops; (3) the wide disparity between prices received by growers and the cost of distribution; (4) dissatisfaction on the part of growers with returns from sales through other outlets; (5) rivalry between villages or towns; (6) desire for cash sales on the part of growers; and (7) relatively low costs of operation.

On the basis of estimates by the United States Department of Agriculture, approximately 2.3 per cent of the total production of all fruits and vegetables in the 10 Eastern Seaboard States were sold at country fruit and vegetable auctions. For the 10 States as a whole, however, sales at these auctions included almost one-half of the strawberries, and about 40 per cent of the lima beans, cauliflower, and cantaloupes offered for sale in these States.

The average number of growers patronizing each auction daily was 160, and the range was from 15 to 400. The average number of buyers at each auction daily was 16, and the range was from 2 to 75. The average gross value of fruits and vegetables handled in 1936 was about $142,000 per auction. The range was from less than $2500 to slightly more than $600,000.

By most measures of size, auctions in northern States were larger than those in southern States. Cooperative auctions were larger than private or municipal auctions.

Factors, on which data could be obtained, that seemed to have had an important influence on the quantity of fruits and vegetables sold per auction were: (1) number and kind of commodities handled; (2) length of operating season; (3) distance to nearest competing auction; and (4) size of the area served.

About two-thirds of the auction income was from fees paid by growers, about one-fourth from brokerage fees paid by outside buyers, and about 8 per cent from auction fees paid by buyers. Auction fees paid by growers ranged from 0.14 to 5.13 cents, and averaged about two cents per dollar of sales at the 60 auctions making such charges.

The range in total expenses per dollar of sales for all auctions was from one-tenth of one cent to 5.15 cents, and averaged about 1.2 cents per dollar of sales. Factors which seem to have had important influence on the total expenses per dollar of sales for the 64 auctions in 1936 were: (1) volume of sales per auction; (2) number of commodities handled; (3) length of operating season; (4) efficiency in the use of labor; and (5) type of ownership.

Some of the factors which seemed to influence the extent to which a grower used the auction were: (1) distance from his farm to the auction; (2) the size of his business; and (3) his attitude towards auctions. Approximately 58 per cent of 375 growers, who sold at auction in 1936, indicated that "higher net returns" was the major reason why they used this method of sale.

Total fruit and vegetable purchases in 1936 by 114 auction buyers interviewed, averaged about $102,000 per buyer. Some of the factors which seemed to influence the extent a buyer used auctions were: (1) the type of buyer; (2) number of years he had been in the fruit and vegetable business; (3) whether or not he was the owner or part owner of the auction; (4) the buyer's attitude toward auctions; (5) distance of an auction from his place of business; and (6) the size of his business.

About 58 per cent of the total fruit and vegetable purchases of these 114 auction buyers was estimated to have been made at country auctions, about 33 per cent at small local markets other than country auctions, 9 per cent at the farm, and less than one per cent at city markets.

Of the total sales by all auctions, about 40 per cent was estimated by auction officials to have been made to local country dealers; about 13 per cent to country dealers from other shipping points; 29 per cent to merchant truckers; 14 per cent to city wholesalers, jobbers, or their representatives; 3 per cent to buyers for canneries, juice plants, or wine factories; and about 1 per cent to all other types of buyers.

In some States, country fruit and vegetable auctions were important outlets; in others they played a relatively minor role. They may become significant factors in the marketing of certain commodities in States like New York, where they were relatively unimportant in 1936.

The total number of country fruit and vegetable auctions will probably increase. Two or three which operated during 1936 have ceased to operate since then because they were located too close to larger and more successful auctions. Other auctions, which were unwisely established, will probably cease operations. However, at least six new auctions have been established during the same period, all of which are sufficiently distant from other auctions. The number of new auctions which are established on sound economical principles will probably exceed the number which fail.

The chances of success seem greatest where large volumes of relatively perishable vegetables and fruits are available in season, where no competing auction is located closer than 15 miles or more, where period of operation can be restricted to the season when large volumes may be handled daily, where minimum investments in physical equipment are made, and where maximum use can be made of hired personnel.

Individuals or groups of growers in northeastern States who are contemplating establishment of new country fruit and vegetable auctions will probably find it advantageous to proceed slowly and study carefully the auctions now operating in New Jersey, New York, Connecticut, and Massachusetts, before deciding upon local operations.

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SOME FACTS CONCERNING COUNTRY FRUIT AND VEGETABLE AUCTIONS IN EASTERN SEABOARD STATES[1]

E. W. Cake

Although fruits and vegetables have been sold at city auctions in the United States for more than a century, country fruit and vegetable auctions on the Eastern Seaboard were unknown prior to 1911. Such country auctions increased slowly in number, and by 1927 there were only 20 in operation. Since that year, however, the number of such auctions has more than trebled, and many cooperative associations, growers, and dealers have evidenced intense interest in the possibilities of this method of marketing (table 1). In 1937, at the request of farmers' organizations and farmers' cooperative associations, the New York State College of Agriculture, in cooperation with the Cooperative Research and Service Division of the

TABLE 1. Number of Country Fruit and Vegetable Auctions, and Estimated Volume of Sales, 10 Eastern Seaboard States, 1911–36*

Year	Auctions operating	Total sales	Sales per auction
	Number	*Packages*	*Packages*
1911	1	10,000	10,000
1912	3	76,000	25,333
1913	3	132,000	44,000
1914	3	180,000	60,000
1915	4	199,000	49,750
1916	4	224,000	56,000
1917	4	248,000	62,000
1918	6	262,000	43,667
1919	6	303,000	50,500
1920	10	488,000	48,800
1921	11	617,500	56,136
1922	13	816,214	62,786
1923	13	952,882	73,299
1924	14	994,145	71,010
1925	18	1,344,385	74,688
1926	19	1,606,065	84,530
1927	20	1,499,366	74,968
1928	28	1,896,503	67,732
1929	31	2,115,621	68,246
1930	39	2,481,718	63,634
1931	43	3,599,750	83,715
1932	50	4,245,382	84,908
1933	56	5,487,691	97,994
1934	60	6,615,559	110,259
1935	64	7,965,539	124,462
1936	64	8,608,558	134,509

*Data were obtained from 64 country fruit and vegetable auctions which operated during 1936, and from 9 which ceased operating before 1936. 1911 was the first year in which auctions of this type began operating in the Eastern Seaboard States.

Author's acknowlegments. This study was conducted under the general direction of Dr. M. P. Rasmussen, Professor of Marketing, New York State College of Agriculture at Cornell University, through a cooperative arrangement between the New York State College of Agriculture and the Farm Credit Administration. The author wishes to express appreciation to Dr. Rasmussen as well as to the auction managers, owners, and other officials, and to auction buyers, grower-patrons, and others, whose cooperation made this study possible.

[1] Also presented to the faculty of the Graduate School of Cornell University, June, 1939, as a thesis in partial fulfillment of the requirements for the degree of doctor of philosophy.

Farm Credit Administration, undertook a study of the status of country fruit and vegetable auctions.

PURPOSE OF STUDY

The purpose of this study was to obtain such facts as might be available concerning country fruit and vegetable auctions which might assist growers, cooperative associations, and others in appraising the importance and effectiveness of such auctions in marketing fruits and vegetables. It was hoped that such a study might throw some light on the factors which are most important in determining success or failure of country fruit and vegetable auctions.

SCOPE OF STUDY

Data were obtained from 64 country fruit and vegetable auctions which operated during 1936 in 10 Eastern Seaboard States, and from 9 which ceased to operate before 1936. These auctions were found in 10 States ranging from Massachusetts on the north, to Florida on the south (figures 1 and 2). Fifty-four, or almost 85 per cent, of these auctions were found in five States, Virginia, North Carolina, Maryland, New Jersey, and Delaware (table 29, appendix). Information concerning use made of these auctions was also obtained from 431 growers of fruits and vegetables as well as from 114 buyers, who purchased produce on one or more of these auctions.

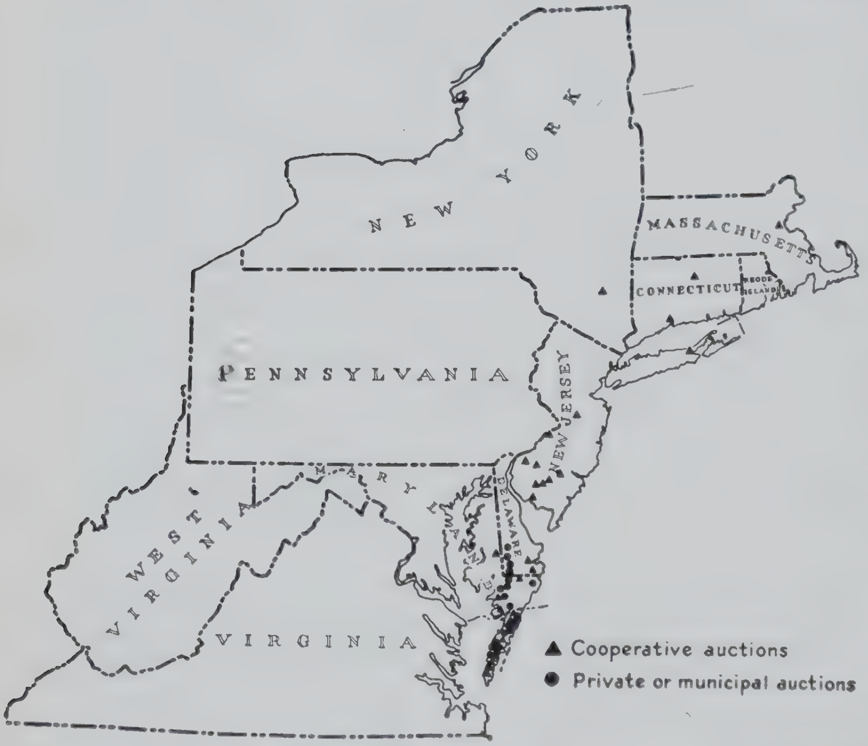

FIGURE 1. LOCATION OF 48 COUNTRY FRUIT AND VEGETABLE AUCTIONS WHICH OPERATED DURING 1936

This study covered auctions which handled fruits and vegetables that arrived via motor truck, wagon, or automobile at country shipping points or farmers' markets; employed an auctioneer; and had physical facilities for conducting an auction business.

FACILITIES USED FOR AUCTION PURPOSES

Facilities used by these 64 auctions varied from simple, single-drive open-end sheds (figure 3), to double-driveway sheds (figure 4), and relatively large and elaborate buildings (figure 5). In the shed-type facilities (figures 3 and 4), the shed usually provided seats for buyers and protected them from rain and sun. Platforms or benches, on either side of the driveway, enabled buyers to inspect produce as it moved through the open driveway and was offered for sale by the auctioneer. Procedure at the most elaborate auction (figure 5) may have been influenced by near-by tobacco auctions. When the auction was operating, driveways were occupied by motor trucks and wagons loaded with produce, and sample packages from each load were placed on the center platform. The auctioneer, accompanied by buyers, walked up and down the platform, and produce was sold on the basis of the samples displayed.

AUCTIONS IN 4 NORTHERN STATES IN 1936[2]

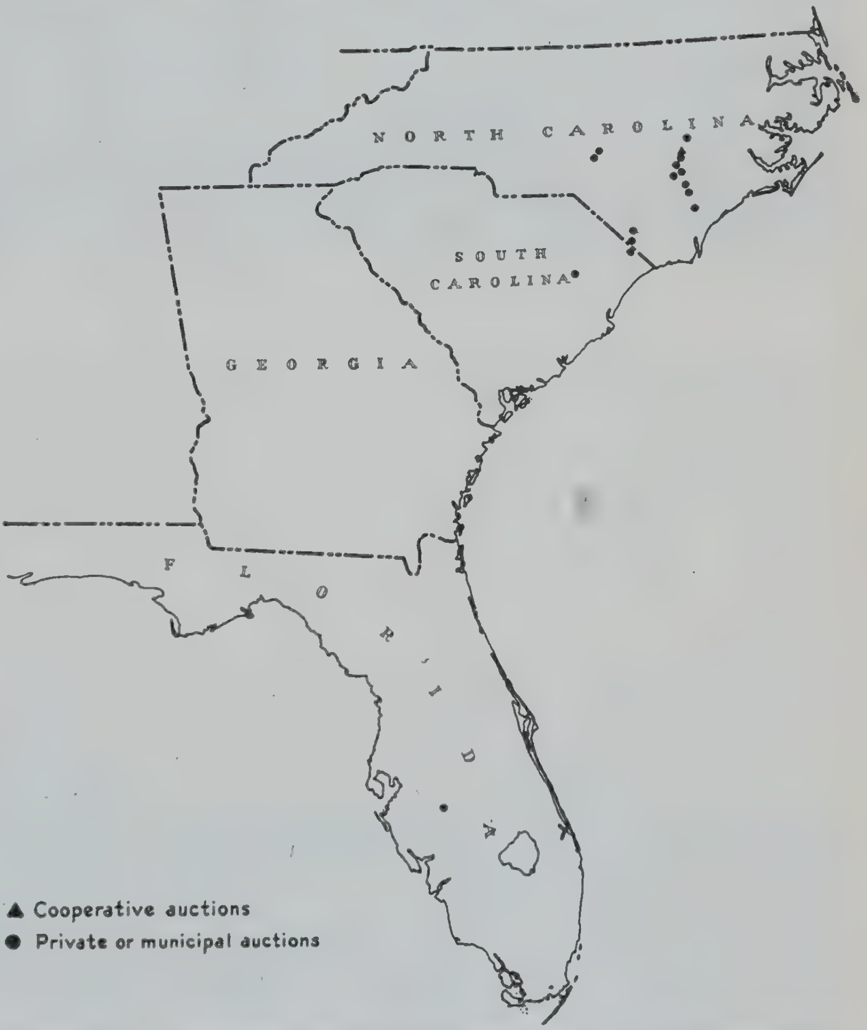

Figure 2. LOCATION OF 16 COUNTRY FRUIT AND VEGETABLE AUCTIONS WHICH OPERATED DURING 1936

The quantity of produce sold through country fruit and vegetable auctions in the 4 northern States increased from about 55,000 packages in 1912, to more than 4 million packages in 1936 (table 30, appendix). Development of auctions has been much more rapid in some States than in others.

Massachusetts. An auction was established in the fall of 1935 at the Boston Regional Produce Market, West Cambridge. This auction handled a wide variety of fruits and vegetables, but in 1936, apples were most important in volume of sales.

Connecticut. One auction organized in 1932 operated at the farmers' market in New Haven, Connecticut, during 1936. Another was organized at Manchester in 1933. The volume of business at these auctions has increased substantially each year since they were organized. The New Haven auction handled mainly strawberries. At the Manchester auction, a wide variety of fruits and vegetables were available, of which cauliflower, strawberries, and peaches were most important.

New York. Two of the 64 auctions which operated in 1936, were located in New York State. The Riverhead Cauliflower Growers' Association, at Riverhead, Long Island, is the second oldest auction of this type in the East. It was established in 1912, one year after an auction began operations at Marion Station, Maryland.

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[2] The term *northern States* as used in this report means the States of Massachusetts, Connecticut, New York, and New Jersey.

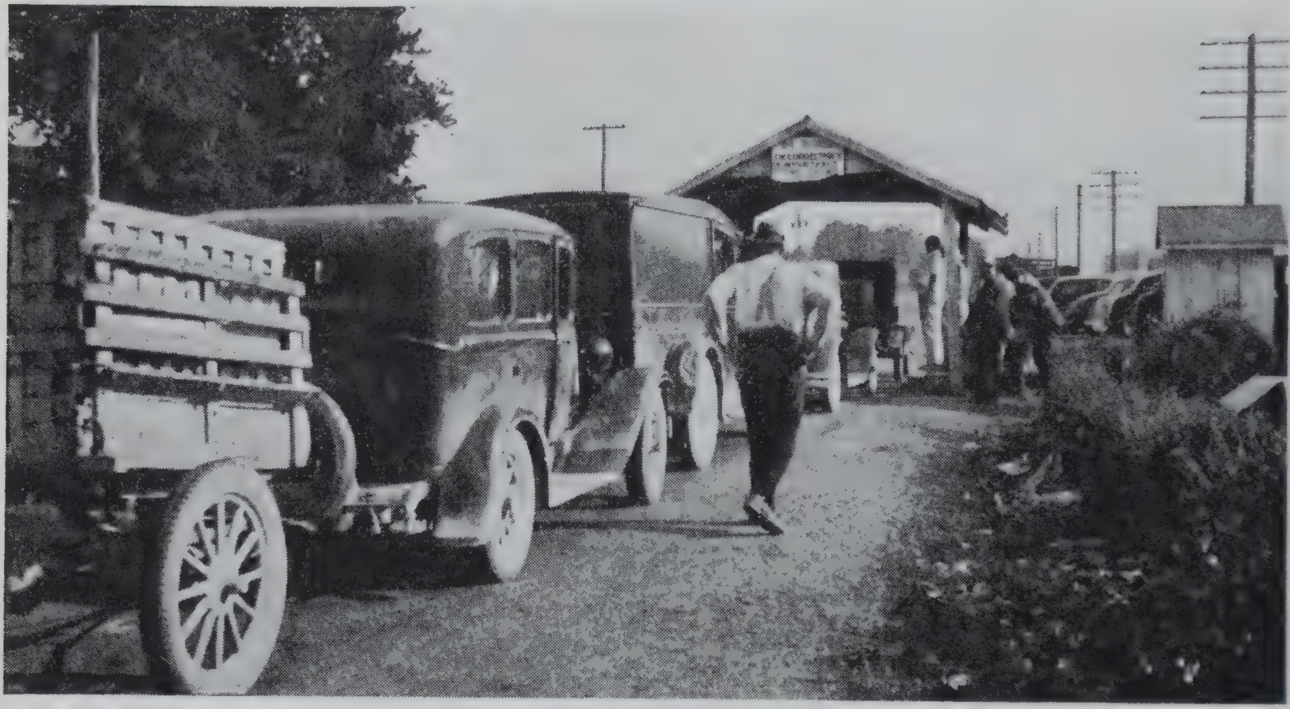

FIGURE 3. SIMPLE SHED FACILITY, ERECTED ACROSS HIGHWAY, BRIDGEVILLE, DELAWARE

Nearly 800 growers patronized the Riverhead auction during 1936, and only one other auction of this type did a larger business, whether measured in number of packages of fruits and vegetables sold or in gross dollar sales.

The Mid-Hudson Fruit Auction was operated by the Cooperative Grange League Federation, Inc., at Highland, New York, in the Hudson River fruit belt, and handled mostly fruit.

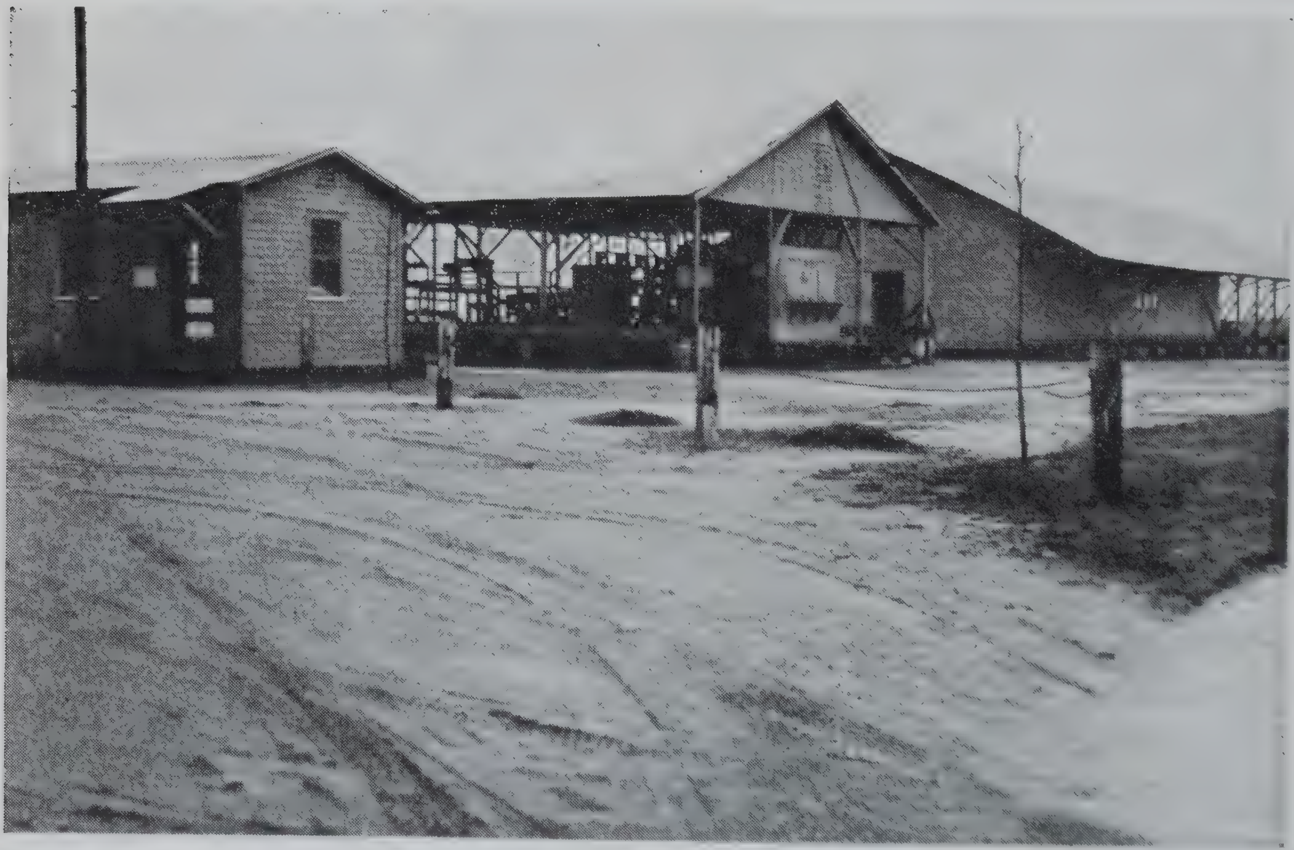

FIGURE 4. DOUBLE-DRIVEWAY AUCTION FACILITY, WITH OFFICE BUILDING AND LOADING PLATFORMS, GLASSBORO, NEW JERSEY

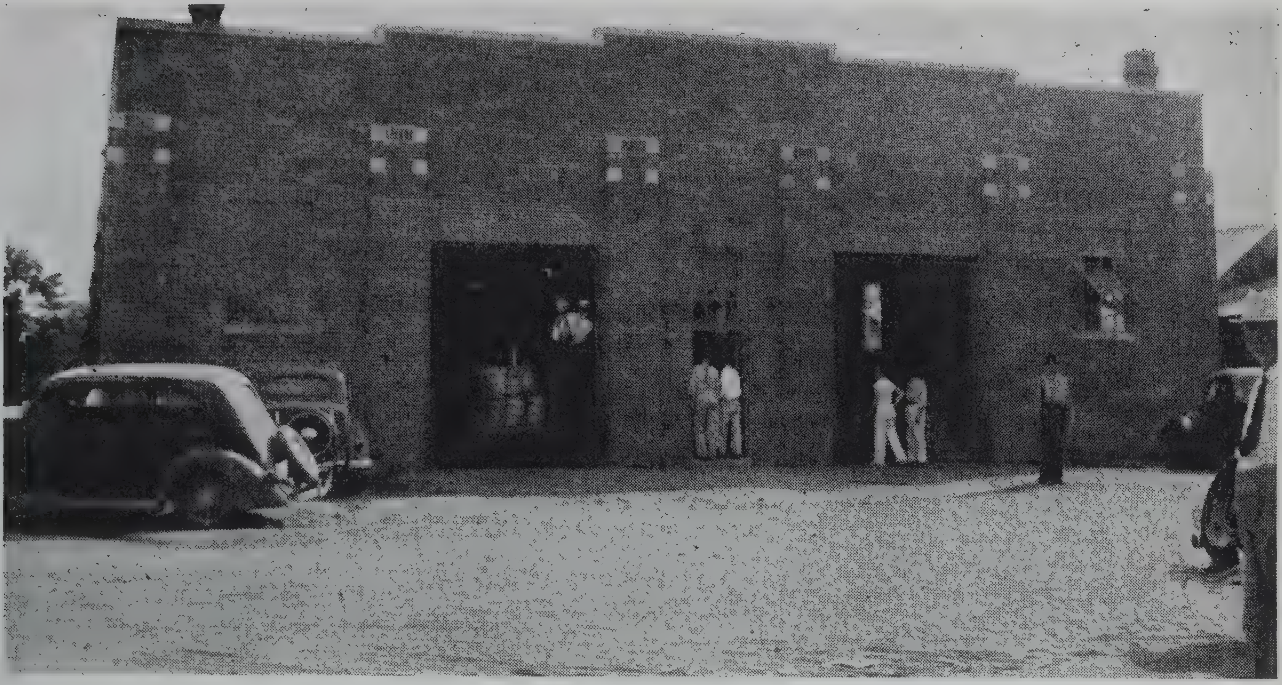

FIGURE 5. LARGE BRICK AUCTION FACILITY, OF DOUBLE-DRIVEWAY TYPE, LAKE CITY, SOUTH CAROLINA

Subsequently to this study, country fruit and vegetable auctions have also been established at Livingston (handling fruit) ; at Margaretville (handling cauliflower) ; at Hicksville, Long Island (handling mostly potatoes and vegetables) ; and at Williamson, in the western New York fruit and vegetable belt.

New Jersey. Auctions were first formed at Cedarville and Rosenhayn, in the intensive berry and vegetable area in the southern part of the State, in 1928. The volume sold at auction grew from about 160,000 packages handled by these two auctions in 1928, to more than 3 million packages handled by 9 auctions in 1936. Fourteen auctions in all have been established in New Jersey, 9 of which operated during 1936.[3] A wide variety of products were handled, such as tomatoes, peppers, cucumbers, snap beans, sweet potatoes, Irish potatoes, onions, cantaloupes, apples, strawberries, etc.

AUCTIONS IN 6 SOUTHERN STATES IN 1936[4]

With the sole exception of the auction at Riverhead, New York, country fruit and vegetable auctions were used much earlier in the South than in the North. Prior to 1928, 19 auctions were in operation in the five southern States from Delaware to South Carolina, and 35 additional auctions had been established in the southern States by 1936. Of all these auctions, 50 operated during 1936.

The volume of sales at these southern auctions increased from about 10,000 packages in 1911 to nearly 4,500,000 packages in 1936.

Delaware. The first country fruit and vegetable auction was established in Delaware about 1920, at Seaford. Six auctions were operating in Delaware in 1936 (table 29, appendix), and strawberries, cantaloupes, cucumbers, and tomatoes were the most important commodities handled.

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[3] Auctions operated during 1936 at Hightstown, Beverly, Swedesboro, Glassboro, Hammonton, Landisville, Vineland, Rosenhayn, and Cedarville.

[4] The term *southern States* as used in this report means the States of Delaware, Maryland, Virginia, North Carolina, South Carolina, and Florida.

Maryland. Auctions in Maryland seem to have limited their activities to that section of the State known as the *Eastern Shore.* The first of all of these auctions was reported as having been established at Marion Station, about 1911, but an additional eleven were subsequently established at other points, and ten of these operated during 1936 (table 29, appendix).

From about 10,000 packages handled by one auction in Maryland during 1911, sales increased to nearly 900,000 packages handled by 10 auctions in 1936. Strawberries, cantaloupes, cucumbers, string beans, and lima beans were the most important commodities handled by Maryland auctions.

Virginia. In 1936, auctions in Virginia were located entirely in Accomac and Northampton Counties on the Eastern Shore. The first auction in Virginia is reported to have been established at Onley about 1912, and there were 18 auctions in operation during 1936 (table 29, appendix).

Volume of sales increased from about 8000 packages during 1912 to nearly 500,000 packages in 1936. Strawberries, string beans, broccoli, and lima beans were the most important commodities handled by Virginia auctions.

North Carolina. Country fruit and vegetable auctions in North Carolina are located in the southeastern part of the State. The first bona-fide auction in the State was established at Tabor City in 1915. By 1936, there were 13 of these auctions in operation in North Carolina (table 29, appendix). Sales had increased from about 8000 packages sold through one auction in 1915 to 1,300,000 packages in 1936. Strawberries, string beans, peas, green peppers, potatoes, sweet corn, cucumbers, and dewberries were the most important commodities handled by North Carolina auctions.

South Carolina. Only two country fruit and vegetable auctions had been established in South Carolina by 1936, one at Loris and another at Lake City. Another auction began operating at Ehrhardt, South Carolina, in 1937.

Florida. A small auction was established in 1934, at Wauchula, Florida. Its volume of business rose rapidly from 1934 to 1936. Cucumbers, strawberries, green peppers, eggplant, string beans, and lima beans were the most important commodities handled. The success of this auction led to the establishment at Wauchula, in 1937, of a large state market which uses the auction method of sale exclusively.

FACTORS INFLUENCING DEVELOPMENT

It seems to be generally agreed that increased possibilities of hauling produce from farm to market by motor truck has been a most important factor influencing the growth of country fruit and vegetable auctions. Although some of the auctions are patronized by buyers who ship by rail, a large share of the patronage comes from buyers of one type or another who transport their purchases in their own or hired motor trucks. The registrations of motor trucks in the United States rose from about 2.4 millions in 1925, to almost 4 millions in 1935, an increase of about 66 per cent during the 11-years period.[5] During the same period, the number of country auctions increased from 18 to 64, or 255 per cent.

It seems likely that the presence of relatively large surpluses at many shipping points may have stimulated efforts to find more rapid and efficient methods of distribution. According to the United States Department of

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[5] Automobile facts and figures, p. 4. Automobile Manufacturers' Assoc. 21st edition. 1939.

Agriculture, the acreage of commercial truck crops for shipment fresh in the North Atlantic and South Atlantic States rose from about 256,000 in 1919, to about 681,000 acres in 1938 (an increase of about 166 per cent).[6]

In 1920, costs of distributing food and prices paid to farmers for food in the United States were in fairly close adjustment; the index number (using the period 1910–1914 = 100) of prices paid to farmers for food material stood at 212, while the corresponding index of costs of distributing food was 203.[7] By 1932 the index of farm prices had fallen to 65 (a decline of about 69 per cent), whereas the cost-of-distribution index had declined only 24 per cent to 153. In 1936, the index of farm prices stood at 117, compared with a cost-of-distribution index of 171. It is probable that the establishment of many country fruit and vegetable auctions from 1928 to 1936 represented desperate efforts on the part of growers to find some way to alleviate the serious maladjustments caused by the sharp decline in the price level of farm products.

Other factors which have probably influenced the establishment of country auctions were dissatisfaction on the part of growers with returns from sales through other outlets, rivalry between villages or towns which may have resulted in the establishment of duplicate auction facilities, and the strong desire on the part of growers to sell for cash. The low operating costs of these auctions was likewise probably an important factor.

OPERATING METHODS AT COUNTRY AUCTIONS

PERSONNEL

Because no two auctions seem to have operated in precisely the same manner, it is difficult to describe them accurately without resorting to infinite detail. The following general observations may be of interest. The number of employees at these auctions varied from one at small auctions, to eighteen or twenty at the larger cooperative auctions, and averaged about four per auction. Some of the larger auctions employed a manager, an auctioneer, a clerk, four or five package boys, an errand boy, two or more other platform men (who open and dump sample packages for inspection by buyers), one or more yardmen, and four or five clerks in the office. Eleven auctions also paid a part of the expense of inspection.

SEASON OF OPERATION

Most of the auctions were closed during the winter and early spring months, and operated only in the late spring or summer. Operations were usually discontinued when income from the daily business was regarded as insufficient to justify expenses. Three auctions, however, operated during the entire year and handled non-perishable commodities during the winter months.

PAYMENT TO GROWERS

At most of the private auctions, growers were paid directly by the buyers. The time and frequency of payment varied from immediately after the sale to a yearly settlement at the end of the season. In most cases, growers collected from the buyers on one or two days a week generally called *pay days.* At private auctions, most outside buyers were required to buy through a local dealer. Growers collected for all auction sales at the offices of the local dealers. Most of the cooperative auctions collected from the buyers, assumed all credit risks, and paid the growers once or twice a week.

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[6] Outlook charts, 1940, potatoes and truck crops, p. 14. U. S. Agr. Dept., Bur. Agr. Econ.
[7] Farm econ., no. 116, p. 2849, January, 1940. New York State Coll. Agr.

CHARGES MADE FOR AUCTION SERVICES

The charges made to growers for services performed by auctions varied considerably. Most of the private auctions charged a stipulated rate per package. Most of the cooperative auctions varied the rate according to the price received or charged a stipulated percentage of the gross sales per package. In a few cases, buyers as well as growers were required to pay a fee to cover certain services performed by the auctions.

RECORDING CONTENTS OF LOADS

All auctions found it necessary to obtain a record of the contents of each truckload, wagonload, or autoload offered for sale. At private auctions, the grower usually called out the number of packages of each commodity in his load on entering the auction shed, and the auction clerk recorded it opposite the grower's name. At a few cooperative auctions, employers interviewed each grower in line before entering the shed, and listed the number of packages of each commodity the grower had for sale.

Most of the cooperative auctions used a "load slip", on which the grower inserted his name and the number of packages of each commodity before arrival at the auction block. The load slip was then handed to the clerk, who copied the information on a permanent record, and at the same time held the slip so the auctioneer could use it as a guide in selling the load. When the sale was concluded, the clerk recorded the price realized per package and the buyer who bought each lot.

SELLING

The sales were usually made from samples shown. Samples of such commodities as string beans and sweet potatoes were dumped in sample bins for inspection. Such commodities as strawberries or cantaloupes were examined by buyers either through the top or side of the package.

If the displayed sample did not fairly represent the lot, the buyer usually was accorded the privilege of rejecting the lot when the grower made delivery. Buyers usually had a man at the truck, shed, or car to check the lots purchased. On all cooperative auctions, the manager or an inspector was ordinarily present to arbitrate disputes between growers and buyers. On private auctions, the disputing parties usually came to terms unassisted. At most auctions, the sale was not considered complete until the buyer or his representative indicated acceptance by signing a receipt for the produce.

At private auctions, sales slips were made out by local buyers, who had the privilege of buying on the block, or by some outside buyer using the sales-slip book of a local buyer, and paying him a brokerage fee. Only one duplicate was made. The grower was given the original and the buyer kept the duplicate. At cooperative auctions, two or three copies were made. If three, the grower received one, the buyer one, and the auction kept the original.

Each lot was sold to the highest bidder, except in the comparatively small number of cases when growers availed themselves of the "no sale" privilege, or refused to sell at the highest price bid. It was a grower's privilege

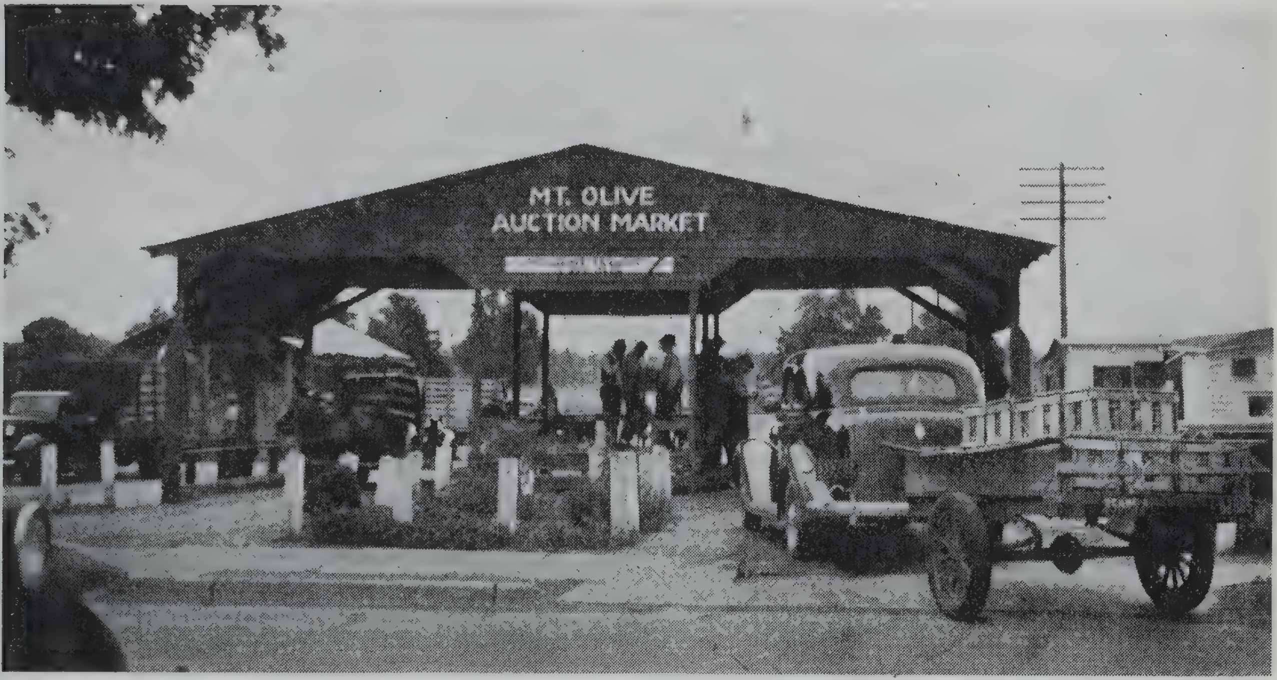

Figure 6. AN AUCTION AT MOUNT OLIVE, NORTH CAROLINA, OPERATED BY AN INFORMALLY ORGANIZED GROUP OF GROWERS, AND ESSENTIALLY COOPERATIVE IN CHARACTER

to "no sale" a lot at any time before it left the auction shed. No auction fee was charged for packages not sold.

OWNERSHIP AND CONTROL

Twenty-seven of the 64 country fruit and vegetable auctions were either owned or operated, or both, by some type of farmers' cooperative association, or informal farmers' group. The auction at Mount Olive, North Carolina, is a typical example of auctions owned and operated by unincorporated farmers' groups (figure 6); while the auction at Highland, New York (figure 7) is an example of ownership and operation by an incorpo-

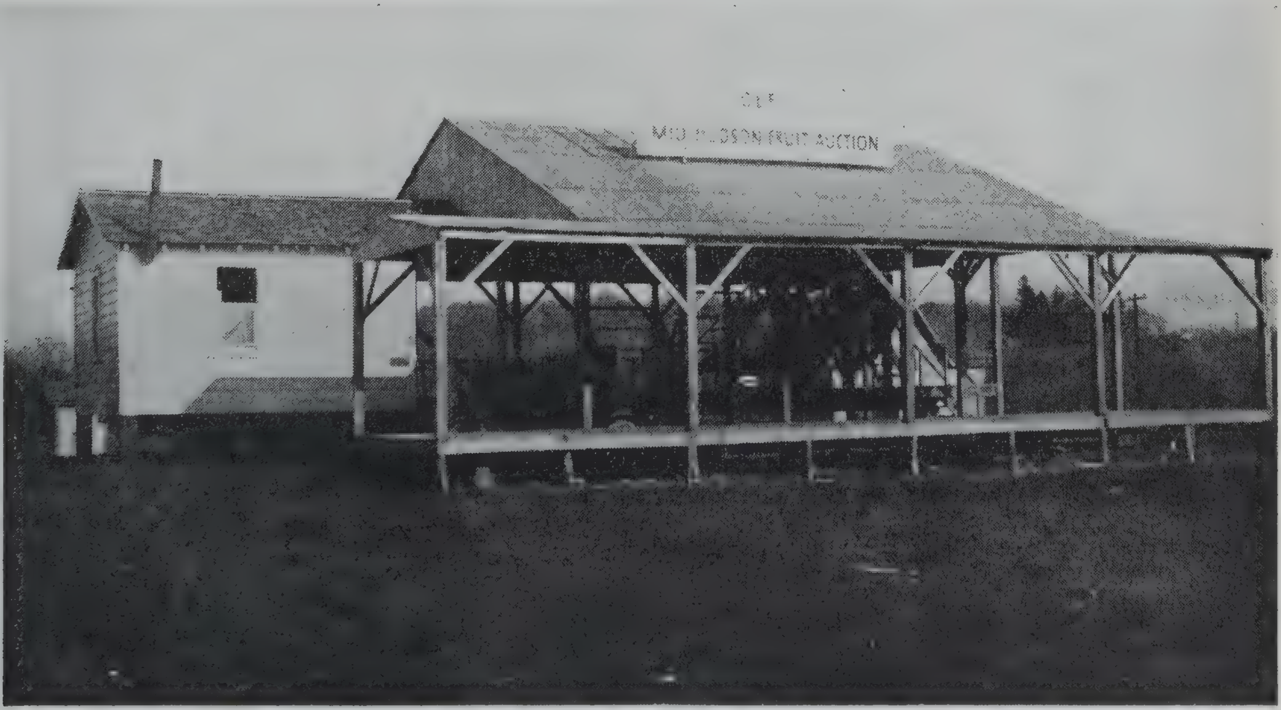

Figure 7. THE MID-HUDSON FRUIT AUCTION, AT HIGHLAND, NEW YORK, WAS OPERATED BY A COOPERATIVE EXCHANGE

rated farmers' cooperative association. Of the remaining 37 auctions, 28 were privately owned and operated by buyers; 5 were owned by municipalities; 2 were owned by local banks; one by a local insurance man; and one by an auctioneer.

COMMODITIES HANDLED

During 1936, 48 vegetables and 18 fruits, in addition to eggs, walnuts, Christmas trees, and holly wreaths, were sold at these 64 country auctions (table 2). Only ten of the 64 auctions handled as many as 15 vegetables, and only as many as 4 vegetables and one fruit were handled by 20 of the auctions.

Over two-thirds of the auctions handled strawberries and more than half handled string beans. Cucumbers, lima beans, and green peas were each handled by about a third of the auctions; and peppers, cantaloupes, squash, tomatoes, Irish potatoes, broccoli, eggplant, cabbage, huckleberries, apples, onions, carrots, pickle cucumbers, and sweet corn by 10 or more of the auctions.

TABLE 2. COMMODITIES HANDLED BY 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS IN 10 EASTERN SEABOARD STATES, 1936*

Commodity	Number of auctions	Per cent of total†
Vegetables:		
String beans	34	53
Cucumbers	28	44
Lima beans	22	34
Peas, green	20	31
Peppers	17	27
Squash	16	25
Tomatoes	15	23
Irish potatoes	12	19
Broccoli	12	19
Eggplant	12	19
Cabbage	11	17
Onions	10	16
Carrots	10	16
Pickle cucumbers	10	16
Sweet corn	10	16
Sweet potatoes	9	14
Spinach	9	14
Dandelion greens	9	14
Scallions	9	14
Beets	9	14
Asparagus	8	12
Fava beans	8	12
Parsley	8	12
Lettuce	7	11
Radishes	7	11
Turnips	7	11
Celery	7	11
Parsnips	7	11
Rhubarb	7	11
Pumpkins	6	9
Okra	6	9
Kale	5	8
Leeks	5	8
Beet greens	5	8
Romaine	4	6
Brussels sprouts	4	6
Cauliflower	4	6
Chinese cabbage	4	6
Mushrooms	4	6
Swiss chard	4	6
Vegetables:		
Sour grass	3	5
Rape	3	5
Shell beans	2	3
Kentucky wonder beans	2	3
Dill	2	3
Kohlrabi	2	3
Chicory	2	3
Poke	1	2
Fruits:		
Strawberries	44	69
Cantaloupes	16	25
Huckleberries	11	17
Apples	10	16
Watermelons	9	14
Blackberries	8	12
Dewberries	8	12
Peaches	7	11
Pears	7	11
Raspberries	7	11
Cherries	7	11
Grapes	7	11
Gooseberries	6	9
Currants	5	8
Plums	4	6
Crabapples	3	5
Quinces	2	3
Cranberries	1	2
Other commodities:		
Eggs	3	5
Walnuts, black	1	2
Christmas trees	1	2
Holly wreaths	1	2

*Massachusetts, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina South Carolina, and Florida.

†Percentages do not add to 100 because many auctions handled more than one commodity.

The 64 auctions handled an average of 8 commodities per auction during 1936. The 14 auctions in the northern States handled an average of 23 commodities per auction, and 50 auctions in the southern States handled an average of 3 commodities per auction during 1936.

TOTAL VOLUME HANDLED

Approximately 8.6 million packages of fruits and vegetables, with a total value of more than 9 million dollars were sold during 1936 at these 64 auctions (table 3). In gross value, strawberries were outstandingly the most important single commodity. Approximately one million crates of strawberries were sold at auction for more than 3.3 million dollars, or more than a third of the total gross value of all commodities sold at auction. In number of packages sold at auction, however, tomatoes ranked slightly above strawberries; and string beans, cantaloupes, cauliflower, cucumbers, and green peppers were almost as important as strawberries.

COMPARISON OF SALES AT AUCTION WITH TOTAL PRODUCTION

The importance of country fruit and vegetable auctions in the distribution of fruits and vegetables may be measured in some degree by the proportion of the total production of all fruits and vegetables which was sold at such auctions in the areas served by these auctions.

TABLE 3. VOLUME OF SALES OF IMPORTANT COMMODITIES,* AS REPORTED BY 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Commodity	Type of package or unit of sale	Packages sold		Gross value	
		Total	Percentage of total	Total	Percentage of total
		Number	*Per cent*	*Dollars*	*Per cent*
Tomatoes	⅝-bushel basket	1,129,190	13.1	426,292	4.7
Strawberries	32-quart crate	1,117,078	13.0	3,305,845	36.5
String beans	Bushel hamper	1,028,507	11.9	945,985	10.4
Cucumbers	Bushel basket	853,361	9.9	620,844	6.9
Cantaloupes	Crate of 24	753,428	8.7	610,902	6.7
Cauliflower	Crate of 12	697,629	8.1	563,044	6.2
Green peppers	Bushel basket or hamper	644,156	8.1	332,782	3.7
Lima beans	Bushel hamper	287,254	3.3	400,643	4.4
Sweet potatoes	Bushel basket or hamper	212,549	2.5	168,482	1.9
Green corn	Bushel crate and 75-ear bag	198,262	2.3	131,366	1.5
Apples	Bushel basket or crate	179,871	2.1	115,746	1.3
Peaches	Bushel and ½-bushel basket	157,817	1.6	134,692	1.5
Onions	50-pound bag	141,832	1.6	110,474	1.2
Watermelons	Each	136,495	1.6	16,594	0.2
Green peas	Bushel hamper	133,479	1.5	147,426	1.6
White potatoes	100-pound sack or 11-peck barrel	123,657	1.4	271,367	3.0
Eggplant	Bushel hamper or basket	75,761	0.9	91,425	1.0
Dewberries	24 and 32-quart crate	55,847	0.6	106,858	1.2
Raspberries	36 and 60-pint crate	31,963	0.4	113,151	1.3
Blackberries	32-quart crate	31,013	0.4	103,829	1.1
Miscellaneous commodities†	Bushel	619,409	7.0	341,276	3.7
Total		8,608,558	100.0	9,059,023	100.0

*Commodities which make up one per cent or more of either the total number of packages, or the total gross value.

†Includes all other commodities not included in the leading 20 (for list of all commodities see table 2, page 16).

The most usable estimate obtainable for the total production of fruits and vegetables in the area served by these auctions is data concerning production of 23 truck crops for market, 9 truck crops for manufacture, and 12 fruit crops.[8] It seems likely that sales at country fruit and vegetable auctions accounted for approximately 2.3 per cent of the total production of all fruits and vegetables in the 10 Eastern Seaboard States.

About 4.6 per cent of the total production of all fruits and vegetables in the five States from New Jersey to North Carolina was sold at country auctions, while less than one per cent was sold by this method in the other five States. Tomatoes, Irish potatoes, sweet potatoes, and citrus and other fruits made up a large proportion of the total fruits and vegetables produced in the 10 Eastern Seaboard States. Only small quantities of these products were sold at country auctions.

For certain crops, however, a relatively large share of the total production was sold at auctions in these States. For the 10 States as a whole, 47 per cent of the strawberries, 43 per cent of the lima beans, 40 per cent of the cauliflower, 38 per cent of the cantaloupes and cucumbers, and about 20 per cent of the green peppers were sold at auction. Approximately 10 per cent of the string beans, green corn, eggplant, and green peas produced in the 10 States was likewise sold at auction. On the other hand, sales at country auctions accounted for only about 4 per cent of the tomatoes, about 2 per cent of the onions, and about one per cent each of the Irish potatoes, sweet potatoes, watermelons, peaches, and apples produced in the 10 States.

RANGE IN VOLUME OF FRUITS AND VEGETABLES HANDLED

The number of packages of fruits and vegetables sold by individual auctions ranged from less than 1000 handled by a strawberry auction in Virginia, to slightly more than 800,000 packages of miscellaneous fruits and vegetables handled by an auction in New Jersey.

Approximately one-fourth of these auctions sold less than 25,000 packages of fruits and vegetables, and 37 of 64 handled less than 100,000 each during 1936 (table 4). On the other hand, 7 auctions handled more than 400,000 packages during the year. The average number of packages handled per auction was about 135,000.

TABLE 4. AVERAGE NUMBER OF PACKAGES OF FRUITS AND VEGETABLES HANDLED, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in number of packages handled*	Auctions	Percentage of total auctions	Average packages per auction
Thousands	*Number*	*Per cent*	*Number*
Less than 25	15	24	11,272
25– 49	11	17	35,986
50– 99	11	17	75,560
100–199	16	25	135,270
200–399	4	6	312,161
400 or more	7	11	542,786
Total or average	64	100	134,509

*The range in volume of business was from 950 to 803,227 packages per auction.

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[8] These data comprise all fruit and vegetable crops for which the Crop Reporting Board, of the United States Department of Agriculture, Bureau of Agricultural Economics, made estimates of production for any of the 10 Eastern Seaboard States in which country fruit and vegetable auctions operated during 1936.

Fruit and vegetable sales per auction varied from less than $2500 to slightly more than $600,000, and the average volume of fruit and vegetable sales for the 64 auctions was about $142,000 per auction (table 5). About 52 per cent reported sales aggregating less than $100,000 for the year, but 5 auctions (or 8 per cent) had average sales of more than half a million dollars.

TABLE 5. AVERAGE GROSS SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in volume of sales*	Auctions	Percentage of total sales	Average volume of sales per auction
Dollars	*Number*	*Per cent*	*Dollars*
Less than 25,000	8	13	9,230
25,000– 49,999	9	14	34,977
50,000– 99,999	16	25	61,622
100,000–199,999	15	23	145,031
200,000–399,999	11	17	268,673
400,000 or more	5	8	510,583
Total or average	64	100	141,547

*The range in volume of sales was from $2470 to $600,120 per auction.

FACTORS INFLUENCING VOLUME OF SALES PER AUCTION

Adequate information was not available to determine *all* of the factors which may have influenced the volume of fruit and vegetable sales per auction. The ability of auctioneers and managers to attract and hold growers and buyers, and the "quality" of the service offered, as well as other intangible factors, cannot be measured statistically. It seems likely that the volume of fruit and vegetable sales per auction depended on various combinations of factors rather than any single one, and that those auctions with the greatest number of favorable factors tended to have the largest volume of sales.

Despite these reservations, such data as are available have been briefly analyzed in the hope that it may be of some assistance to growers and co-operative associations who are interested in existing or prospective country fruit and vegetable auctions.

NUMBER OF COMMODITIES HANDLED

Twenty of these auctions (or about one-third) handled only one commodity, and averaged less than $60,000 worth of fruit and vegetable sales during 1936; while 17 auctions, which handled, on the average, about 22 commodities each, attained fruit and vegetable sales averaging nearly $220,000 each (table 6). For all of the 64 auctions, fruit and vegetable

TABLE 6. RELATION OF NUMBER OF COMMODITIES HANDLED TO SALES PER AUCTION, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in number of commodities handled	Average commodities handled	Auctions in group	Average gross sales per auction
	Number	*Number*	*Dollars*
1	1	20	59,017
2–3	2.3	13	132,543
4–7	5.1	14	175,214
8 or more	21.5	17	217,801

sales averaged nearly $142,000 and 8 commodities were handled per auction.

There appears to have been some relationship between the number of commodities handled and the total dollar volume of sales; that is, the greater the number of commodities handled, the larger the volume of sales. (This may suggest to some auction managers one possible method of increasing sales volume and reducing costs of operation per package.)

KIND OF COMMODITIES

The kind of commodity also seems to have had some influence on fruit and vegetable sales per auction, although the exact effect is not so obvious because of the widely varying conditions under which these auctions operated. Such data as are available, however, indicate that auctions which handled strawberries alone had larger sales than did single-commodity auctions handling either broccoli or dewberries; and that for two out of three groups, auctions handling strawberries in combination with one or more other commodities had larger average sales than did auctions handling combinations of commodities that did not include strawberries (table 7). Strawberries and relatively perishable fruits and vegetables seem to be particularly well adapted for sale at country fruit and vegetable auctions.

LENGTH OF OPERATING SEASON

There was a wide disparity in length of season during which these 64 auctions operated. Some operated only 11 days, and others throughout the year. Twenty-seven (or about 42 per cent) were open less than 50

TABLE 7. NUMBER AND KIND OF COMMODITIES HANDLED AND VOLUME OF SALES PER AUCTION, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Number and kind of commodities handled	Auctions	Fruit and vegetable sales per auction
	Number	*Dollars*
One commodity:		
Strawberries	16	66,400
Broccoli	2	10,750
Dewberries	2	48,220
Total or average	20	59,017
Two or three commodities:		
Strawberries and one or two others	7	157,882
Cantaloupes and cucumbers	3	154,614
String beans and lima beans	2	51,425
Green peppers and squash	1	51,200
Total or average	13	132,543
Four to seven commodities:		
Strawberries and several vegetables	9	169,508
Several vegetables	5	185,486
Total or average	14	175,214
Eight or more commodities:		
Strawberries and several vegetables	12	245,463
Several fruits and vegetables	5	151,411
Total or average	17	217,801
All auctions	64	141,547

days during 1936, and 7 (or about 10 per cent) operated 150 days or more (table 8).

It will be noted that the auctions which operated for only relatively short periods had relatively small sales (about $75,000 per auction), and that the largest volume of sales (about $257,000) was obtained by the auctions which operated for an average period of about 229 days.

In areas where a sufficient number of commodities are available in relatively large volume in season, it seems likely that extending the period of operation may result in substantially larger volumes of sales.

TABLE 8. RELATION OF LENGTH OF OPERATING SEASON TO SALES OF FRUITS AND VEGETABLES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in length of operating season	Average length of operating season	Auctions in each group	Average gross sales of fruits and vegetables per auction
Days	*Days*	*Number*	*Dollars*
Less than 50	27	27	75,526
50– 99	69	16	169,993
100–149	119	14	176,476
150 or more	229	7	257,467

DISTANCE TO NEAREST COMPETING AUCTION

In some areas, auction facilities may have been developed too hastily and in too close proximity to one another for maximum efficiency. For all 64 auctions, the range in distance to the nearest competing auction was from less than one mile to approximately 150 miles. Two of these auctions were located at one small shipping point on the Eastern Shore of Virginia, and were only about one-tenth of a mile apart; whereas the auction at Riverhead, New York, was approximately 150 miles from its nearest competing auction in 1936.

The average distance to the nearest competing auction for all auctions which operated in 10 Eastern Seaboard States during 1936 was about 16 miles. At that time, 28 per cent were less than 5 miles from the nearest competing auction, 28 per cent from 5 to 9 miles, 27 per cent from 10 to 14 miles, and 17 per cent were located 15 miles or more from their nearest competitor (table 9).

The auctions which were less than 5 miles from the nearest competing auction, reported fruit and vegetable sales averaging about $100,000; those

TABLE 9. RELATION OF DISTANCE TO NEAREST COMPETING AUCTION TO SALES OF FRUITS AND VEGETABLES PER AUCTION, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in distance to nearest competing auction	Average distance to nearest competing auction	Auctions in group	Average sales of fruits and vegetables per auction
Miles	*Miles*	*Number*	*Dollars*
Less than 5	3	18	100,237
5– 9	7	18	119,406
10–14	11	17	164,594
15 or more	61	11	209,760

from 5 to 9 miles from competing auctions had average sales of nearly $120,000; while the 11 auctions located 15 miles or more from their nearest competitors averaged about $210,000. The closer the auctions were to one another, the more difficult it seems to have been to obtain an adequate volume of business. It should be noted that 53 of the 64 auctions had another auction not over 14 miles distant. It seems likely that some of the near-by auctions, within 5 or 10 miles of one another, might find it advantageous to consolidate their operations. New auctions should probably not be established within 10 or 15 miles of other auctions.

AREAS SERVED

The diameter of the average area served by these 64 auctions was estimated at about 21 miles. Eight auctions served areas less than 10 miles in diameter, 21 auctions from 10 to 19 miles, 22 auctions from 20 to 29 miles, and 13 auctions served areas with estimated diameters of 30 miles or more. The range in the diameters of the areas served was from 4 to 60 miles. Two of the auctions on the Eastern Shore of Virginia drew growers from not more than 2 miles in each direction, while the auction at Wauchula, Florida, was patronized by growers from six counties extending 30 miles in each direction.

The 8 auctions which served areas with estimated diameters of less than 10 miles had average fruit and vegetable sales of less than $15,000, while the 13 auctions which served areas 30 miles or more in diameter averaged nearly $390,000 in fruit and vegetable sales during 1936 (table 10). Careful consideration of the size of the producing area which is available to be served by an auction, as well as the intensity of production of fruits and vegetables adaptable to auction sale, would seem to be basic requisites to the establishment and maintenance of successful auctions.

TABLE 10. RELATION OF APPROXIMATE AREA SERVED TO SALES OF FRUITS AND VEGETABLES PER AUCTION, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in diameter of area served	Average diameter of area served	Auctions in each group	Sales of fruits and vegetables per auction
Miles	*Miles*	*Number*	*Dollars*
Less than 10	6	8	14,518
10–19	15	21	69,205
20–29	23	22	170,137
30 or more	36	13	288,197

SOURCES OF INCOME FOR AUCTIONS

FEES PAID BY GROWERS

Fees paid by growers were the most important source of income, amounting to approximately $165,000 (or about two-thirds of the total) for all auctions during the calendar year 1936. Brokerage fees paid by outside buyers to local brokers accounted for about 25 per cent (table 31, appendix).

There were many different systems or schedules of fees charged growers in 1936. Of the 14 northern auctions, 7 used systems of variable fees based on value per package or size of package. The other 7 northern auctions charged either a percentage of gross sales, or a definite fee per package, regardless of size or value.

Sixteen of the southern auctions which handled strawberries only, charged growers a standard fee of about two cents per crate. At the remaining southern auctions, auction fee systems or schedules were highly varied, but most of them used systems of fees based either on the size of packages or types of commodities.

The range in auction fees paid by growers in 1936 at the 60 auctions where such charges were made, was from 0.14 to 5.13 cents per dollar of sales, and the average auction fee paid by growers was about two cents per dollar of sales.

There was considerable variation between States in the size of auction fees paid by growers per dollar of sales. The average auction fee paid by growers at 14 northern auctions was about 2.7 cents per dollar of sales (table 11). Auction fees paid by growers at 46 southern auctions were appreciably lower, and averaged only about 1.6 cents per dollar of sales.

TABLE 11. AUCTION FEES PAID BY GROWERS PER DOLLAR OF SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

State	Auctions in State	Auctions at which fees were paid by growers	Average auction fees per dollar of sales
	Number	*Number*	*Cents*
Northern States:			
Massachusetts, Connecticut, and New York combined	5	5	2.78
New Jersey	9	9	2.64
Total or average	14	14	2.69
Southern States:			
Delaware	6	5	1.60
Maryland	10	8	1.37
Virginia	18	18	0.86
North Carolina	13	12	2.10
South Carolina and Florida combined	3	3	1.24
Total or average	50	46	1.56

FEES PAID BY BUYERS

Auction fees charged buyers were of much less importance as a source of income than were fees paid by growers, and only 10 of the 64 auctions charged buyers such fees. Five auctions, located on the Eastern Shore of Virginia, made an 8-cent-per-crate charge to buyers of strawberries. In return for this charge, the auctions performed various services for the buyers, such as keeping their accounts with the growers, paying growers weekly by check, and checking and inspecting growers' loads when transferred to buyers' trucks. In Virginia, fees paid by buyers *were* the most important source of income to the auctions. Auction fees charged buyers by the 10 auctions in 1936 varied from 0.57 to 4 cents, and averaged about 1.5 cents per dollar of sales.

BROKERAGE FEES PAID BY OUTSIDE BUYERS

Income realized from brokerage fees[9] paid by outside buyers to local buyers, who either own or help control auctions, would not ordinarily be considered by the local buyers (who actually receive the fees) as a source of income to the auctions. At most of the auctions where such fees were charged, however, these local buyers owned and controlled the auctions either partially or entirely. Consequently, the fees charged outside buyers for the privilege of buying on the auctions were, for all practical purposes, a source of income to those who operated the auction. Of approximately $250,000 of gross income received by all auctions, brokerage fees paid by outside buyers made up almost $64,000 (or about one-fourth); auction fees paid by buyers about $19,500 (or 8 per cent); and auction fees paid by growers were more than $165,000 (or about two-thirds of the gross income).

The range in brokerage fees paid by outside buyers to local buyers was from 0.09 to 3.61 cents, and averaged 1.32 cents per dollar of sales.

OTHER INCOME

Seven auctions had sources of income other than the three major sources already considered. At six of these auctions, the income was from lunchstands rented out as concessions. The annual rentals from lunchstands ranged from $91 per season at a Connecticut auction, to $216 at a New Jersey auction, and averaged approximately $143 each for the six auctions. A seventh auction, located in South Carolina, received annual rentals totaling $423 for office space rented to buyers in the auction building.

Two auctions refunded to growers a portion of the charges collected from them in 1936. One of these auctions returned nearly one-half of all charges it had collected from growers during the year. Because of an unusually large local crop of its principal commodity, this auction had a volume of business in 1936 more than double that of any previous season. Charges to growers were assessed at the same rate as in former years, and approximately $3400 of the charges collected were refunded.

NET INCOME

Consolidated reports for all 64 auctions of the income derived from all sources showed a gross income of $249,932, with refunds of $3565 of auction fees, leaving $246,367 net income for all auctions. For most purposes, however, the net income to auctions (not including as income brokerage fees paid by outside buyers) might be desired rather than the net income including such brokerage fees. The range in net income for 61 auctions (not including brokerage fees paid by outside buyers to local buyers) was from 0.14 to 6 cents per dollar of sales. For all of these 61 auctions, net income averaged 2.15 cents per dollar of sales (table 12).

EXPENSES[10]

The total deductions from the gross price paid at auction which resulted from the handling of produce by these country fruit and vegetable auctions

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[9] Fees paid by buyers who for any reason (usually inability to establish a credit rating, or monopoly in the control of the auction by certain local buyers) were either required to buy, or found it to their financial advantage to buy through some local buyer.

[10] The term *expenses* has been used in this analysis rather than *costs* or *operating costs* because it was possible to obtain balance sheets from only a few of the auctions; and therefore, interest on average net worth has not been considered. An item of expense has been included for interest on average investment in physical facilities (buildings, land, equipment, and office supplies), but this would not be the same as interest on average net worth for all auctions.

TABLE 12. NET INCOME PER DOLLAR OF SALES, EXCLUDING BROKERAGE FEES PAID BY OUTSIDE BUYERS TO LOCAL AUCTION BUYERS, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

State	Auctions in State	Auctions with income other than brokerage fees	Average net income per dollar of sales (excluding brokerage fees paid by outside buyers)
	Number	*Number*	*Cents*
Northern States:			
Massachusetts, Connecticut, and New York, combined	5	5	2.44
New Jersey	9	9	2.79
Total or average	14	14	2.68
Southern States:			
Delaware	6	5	1.62
Maryland	10	8	1.37
Virginia	18	18	2.21
North Carolina	13	13	2.08
South Carolina and Florida, combined	3	3	1.48
Total or average	50	47	1.84

ranged from 0.73 to 7.11 cents per dollar of sales. At four of these auctions, total deductions from gross price were less than one cent per dollar of sales; while at eight auctions, total deductions averaged 5.49 cents (table 13).

TABLE 13. TOTAL COSTS OF HANDLING FRUITS AND VEGETABLES PER DOLLAR OF GROSS SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936*

Range in total costs per dollar of sales	Auctions in each group		Average total cost per dollar of gross sales
		Percentage of total	
Cents	*Number*	*Per cent*	*Cents*
Less than 1	4	6	0.87
1–1.99	20	31	1.69
2–2.99	12	19	2.64
3–3.99	15	23	3.40
4–4.99	5	8	4.45
5 or more	8	13	5.49

*Does not include items of *other income*.

For practical purposes, items of expense incurred by these 64 country auctions may be segregated into four groups: (1) personnel, which averaged $1205 per auction; (2) property, which averaged $238; (3) supplies and services, $128; and (4) miscellaneous, $118 (table 14).

PERSONNEL

Since all of the auction employees had some definite and active duty to perform when the auction was in operation and such duty usually involved labor, it seemed impracticable to classify the wages of certain of the employees as *salaries,* and those of others as *labor expense.* The term *personnel expense* seems to describe most nearly accurately the items involved. Personnel expense included wages paid to auctioneers, managers, inspectors, auction clerks, office clerks, and other employees, as well as employees' liability insurance.

The ratio of personnel expense to total expense ranged from about 58 per cent in the South Carolina - Florida area, to about 85 per cent in Virginia, and averaged about 71 per cent for all 10 States (table 32, appendix).

TABLE 14. AVERAGE COMBINED INCOME AND EXPENSE STATEMENT FOR 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Item	Weighted average per auction	Auctions having each item	
			Average
	Dollars	*Number*	*Dollars*
Income:			
Auction charges to growers	2,583	60	2,755
Auction charges to buyers	305	10	1,953
Brokerage fees paid by outside buyers	997	38	1,679
Other income	20	7	183
Gross income	3,905	64	3,905
Auction charges refunded to growers	–56	2	–1,782
Net income	3,849	63	3,911
Expenses:			
Personnel:			
Auctioneer	381	63	387
Manager	188	24	502
Inspectors	188	11	1,091
Auction clerk	141	42	215
Office clerks	129	24	343
Other employees	171	36	304
Employees' liability insurance	7	7	64
Total personnel expense	1,205	64	1,205
Property:			
Interest on investment in physical facilities at 5 per cent	72	61	76
Repairs and construction	60	27	141
Depreciation on buildings	43	55	50
Rent	31	30	66
Insurance	16	18	55
Taxes	9	13	45
Depreciation and purchases of equipment	7	10	43
Total property expense	238	64	238
Supplies and services:			
Office supplies	48	31	101
Bank service	23	2	751
Auction supplies	21	24	55
Telephone and telegraph	21	26	52
Light and heat	11	17	40
Other	4	8	28
Total service expense for supplies and services	128	54	152
Miscellaneous:			
Miscellaneous operating expense	62	46	87
Traveling expense	25	9	182
Advertising and publicity	10	12	53
Bad debts	7	3	148
Interest on borrowed money	5	5	68
Miscellaneous office expense	4	8	28
Other	5	3	98
Total miscellaneous expense	118	50	152
Total expense	1,689	64	1,689
Net profit	2,160	60	2,305
Net profit (exclusive of brokerage fees paid by outside buyers)	1,163	50	1,490

Wages paid to auctioneers (figure 8) varied from about 15 per cent of the total expense in New Jersey, to nearly 45 per cent in Maryland, and averaged about 23 per cent for all 10 States. All but one of the auctions employed auctioneers in 1936.

Twenty-four auctions employed individuals in the capacity of managers in 1936. Some other employee acted in this capacity at other auctions. Wages to managers hired or appointed as such, ranged from zero to 16 per cent.

Eleven auctions employed inspectors. Wages or fees paid to inspectors varied from zero to about 36 per cent. Since only one auction in the northern States employed inspectors in 1936, the proportion of total expense made up by this item was only about 5 per cent in these States, as compared with about 21 per cent in the 6 southern States (table 32, appendix).

Forty-two auctions employed auction clerks. The proportion of total expense made up of wages to auction clerks was from approximately 4 per cent to nearly 17 per cent.

Twenty-four auctions employed office clerks. The proportion of total expense made up of wages to office clerks varied from a little less than 2 per cent to about 11 per cent.

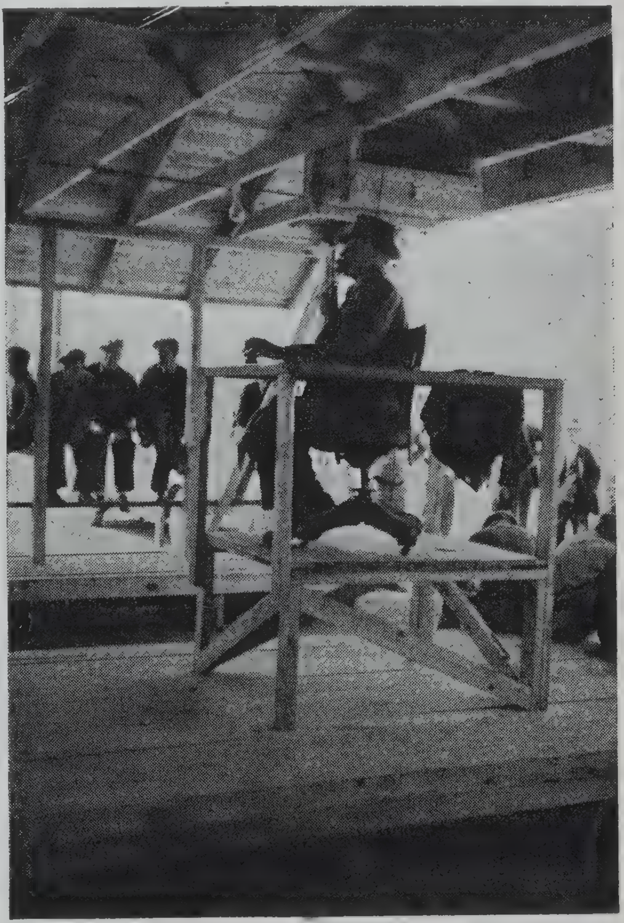

FIGURE 8. AUCTIONEER AT WALLACE, NORTH CAROLINA

All but one of the 64 auctions employed auctioneers in 1936

Thirty-six auctions had employees other than those listed above, and these accounted for 10 per cent of the expense. The range in total expense made up by wages to "other employees" was from a little less than 5 per cent in Maryland and Delaware to about 27 per cent in Virginia.

PROPERTY

Property expense varied from 5.8 per cent of all costs in Virginia to almost 40 per cent in the South Carolina - Florida area, and averaged about 14 per cent for the entire 64 auctions (table 32, appendix).

SUPPLIES AND SERVICES

Supplies and services accounted for about 2 per cent in the South Carolina - Florida area, and about 13 per cent in North Carolina, with an average of almost 8 per cent for all areas (table 32, appendix).

Country auctions seem to be relatively inexpensive to operate. Total expenses per dollar of sales for all auctions ranged from one-tenth of one cent to 5.15 cents, and averaged about 1.2 cents per dollar of sales. The wide range in total expense per dollar of sales, however, may indicate the likelihood that some auctions could lower their expenses considerably, without reducing the services performed. This variation was caused largely by differences in the amount of services offered growers by auctions in the various areas.

For the 14 auctions in 4 northern States, the average total expense was slightly more than two cents per dollar of sales (table 15). In contrast to this, total expense for the 50 auctions in the 6 southern States averaged less than three-fourths of a cent per dollar of sales, or about one-third as much as at the 14 auctions in 4 northern States. Auctions in Delaware showed the lowest average total expense — 0.3 of a cent per dollar of sales.

TABLE 15. TOTAL EXPENSE PER DOLLAR OF SALES FOR 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 1936

State	Auctions	Total expense per dollar of sales
	Number	*Cents*
Northern States:		
Massachusetts, Connecticut, and New York combined	5	1.74
New Jersey	9	2.18
Total or average	14	2.04
Southern States:		
Delaware	6	0.26
Maryland	10	0.48
Virginia	18	0.67
North Carolina	13	1.15
South Carolina and Florida combined	3	0.70
Total or average	50	0.73

FACTORS RELATED TO EXPENSE PER DOLLAR OF SALES

Many factors seem to have been related in some degree to total expense per dollar of sales, and all factors seem to bear a joint relationship to this expense. Even though a relationship may seem to exist between an individual factor and the total expense per dollar of sales, it is difficult to demonstrate that it was not caused indirectly by some other factor. Some of the factors which seemed more or less related to expense per dollar of sales were: (1) volume of sales per auction; (2) number of commodities handled; (3) length of operating season; (4) efficiency in use of labor; and (5) type of ownership.

VOLUME OF SALES

In the 4 northern States, the 5 auctions with the lowest average sales (about $68,000 per auction) had an average total expense of 3.1 cents per dollar of sales, while the 4 auctions with the highest average sales (nearly $490,000 per auction) had an average total expense of only about 1.6 cents per dollar of sales (table 16).

In the 6 southern States, the 17 auctions with the lowest average sales (slightly less than $24,000 per auction) had average expenses of 1.03 cents per dollar of sales, while the 16 auctions with the highest average sales (nearly $260,000 per auction) had an average total expense of 0.7 of a cent

TABLE 16. RELATION OF VOLUME OF FRUIT AND VEGETABLE SALES TO EXPENSE PER DOLLAR OF SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in annual gross sales per auction	Average gross sales per auction	Auctions in group	Average expense per dollar of gross sales
Dollars	*Dollars*	*Number*	*Cents*
Northern States:			
Less than 115,000	68,130	5	3.10
115,000–300,000	209,424	5	2.51
Over 300,000	448,799	4	1.58
Southern States:			
Less than 50,000	23,566	17	1.03
50,000–135,000	79,396	17	0.75
Over 135,000	257,857	16	0.70

per dollar of sales. These data would seem to indicate that large volume of sales per auction was associated with low costs of operation. It is probable that the 16 southern auctions, with largest volumes, would have had even lower costs if their average investment in physical facilities had been more in line with the other 34 auctions in that area.

NUMBER OF COMMODITIES HANDLED

In the 4 northern States, the 5 auctions which handled the fewest commodities (about 10 per auction) reported the lowest total expense (1.5 cents) per dollar of sales (table 17). The two groups which averaged 16 or more commodities per auction had expenses per dollar of sales of about 2.4 cents. The major reason for the differences seems to have been in length of operating season. The auctions handling 26 or more commodities developed somewhat larger sales, but did it at the expense of higher costs for labor through stretching out the season to 204 operating days.

In the 6 southern States, the 20 auctions which handled only one commodity had the highest total expense per dollar of sales (0.95 cent); and the group of 18 auctions which averaged three commodities per auction had the lowest total expense per dollar of sales (0.58 cent).

The southern auctions handling only one commodity had the lowest volume of sales per auction and by far the shortest operating season. Al-

TABLE 17. RELATION OF NUMBER OF COMMODITIES HANDLED TO EXPENSE PER DOLLAR OF SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Commodities handled		Auctions in group	Average expense per dollar of sales	Average length of operating season
Range	Average per auction			
	Number	*Number*	*Cents*	*Days*
Northern States:				
15 or less	10	5	1.50	117
16–25	22	4	2.39	140
26 or more	39	5	2.35	204
Southern States:				
1	1	20	0.95	23
2–4	3	18	0.58	67
5 or more	7	12	0.80	106

though the group handling 5 or more commodities was able to increase volume of business over the 2-to-4-commodities group, the gain in volume seems to have been brought about only by a much longer operating season, with relatively high costs for labor. Merely handling a large number of commodities did not result in lowest operating costs either in the northern or the southern States. Unless substantial quantities of each commodity can be handled each day of operation, it may be an uneconomical venture to add more commodities to the list to be handled.

LENGTH OF OPERATING SEASON

It seems logical to believe that the longer an auction can be operated, with *substantial volume* per day of operation, the lower will be the cost of operation. It does not follow, however, that merely operating the auction for a long period will insure low costs. Of the 14 northern auctions, the 5 which had the shortest operating season (an average of about 65 days) had the lowest total expense (1.34 cents) per dollar of sales, while the group which operated an average of 276 days had expenses averaging 2.77 cents per dollar of sales. The average sales per day approximated $3245 for the first group, and only $830 per day for the second group (table 18).

TABLE 18. RELATION OF LENGTH OF OPERATING SEASON TO EXPENSE PER DOLLAR OF SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Length of operating season		Auctions in group	Average expense per dollar of sales	Average volume of sales per day of operation
Range	Average per auction			
Days	*Days*	*Number*	*Cents*	*Dollars*
Northern States:				
Less than 120	65	5	1.34	3,245
120–175	147	5	2.11	1,649
Over 175	276	4	2.77	830
Southern States:				
25 or less	21	17	0.97	2,850
26–74	49	16	0.66	2,268
75 or more	106	17	0.70	1,709

Of the 50 southern auctions, the 17 with the shortest operating season (an average of only 21 days) had the highest total expense (0.97 cent) per dollar of sales, but also had the largest average sales per day of operation. For the remaining 16 auctions, there seemed to be little difference in expenses of operation whether they operated 49 or 106 days, but the expense of operation was only two-thirds as great per dollar of sales as in the case of the auctions which operated about 21 days. The fact that the 17 with the highest expenses were one-commodity auctions may explain why expenses were so high. Labor expense seems to have been much higher on single-commodity auctions than on those which handled 3 to 5 commodities.

The southern auctions which handled from 3 to 5 commodities seem to have been able to develop from two to three times as great a volume of business as the single-commodity auctions, and to have used its personnel more efficiently.

LABOR EFFICIENCY

Efficient use of personnel should logically be a vital factor in reducing expenses of operation. In both northern and southern States, the auctions which had the largest sales per dollar expended for personnel hire likewise had the lowest total expense of operation per dollar of sales (table 19).

TABLE 19. RELATION OF LABOR EFFICIENCY TO TOTAL EXPENSE PER DOLLAR OF SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936*

Sales per dollar of personnel expense: Range	Sales per dollar of personnel expense: Average per auction	Auctions in each group	Average total expense per dollar of sales
Dollars	*Dollars*	*Number*	*Cents*
Northern States:			
Less than 40	36	5	3.95
40–84	74	4	2.18
85 or more	116	5	1.23
Southern States:			
Less than 118	89	17	1.29
118–210	154	16	1.02
Over 210	396	17	0.31

*Labor efficiency is here measured by gross sales of fruits and vegetables per dollar of personnel expense.

This is probably another way of saying that it is difficult to make efficient use of labor with a relatively small volume of sales, and that costs rise rapidly when enough business is not done to keep the personnel busy.

TYPE OF OWNERSHIP

All of the 14 northern auctions were cooperatively owned, and it was not possible to compare them with privately owned auctions, since none could be found in these States. These northern cooperative auctions performed many services for growers not offered by southern auctions. These services included making collections from buyers and the assumption of credit risks, which entailed a certain amount of loss from uncollectible accounts. Average cost per dollar of sales in the 4 northern States was 2.04 cents.

The services performed by the 50 southern auctions were practically identical, whether the auctions were cooperatively or privately owned. The 37 private or municipal auctions, located in the southern States, reported an average total expense per dollar of sales of 0.8 cent. The average total expense per dollar of sales for the 13 cooperative auctions was 0.54 cent per dollar of sales. The average volume of sale for all private auctions was $117,428, and for the southern cooperatives $117,785. The cooperatives had only $333 invested in physical facilities as compared with $802 for private auctions. The cooperatives operated an average of 42 days as compared with 65 for private auctions. Cooperatives also seem to have made more efficient use of labor, since sales per dollar of personnel expense were $226 for cooperatives and $165 for private or municipal auctions. It thus appears that cooperative auctions have been more than able to hold their own in these southern States.

USE OF AUCTIONS BY GROWERS

Since growers usually have alternative methods of sale from which to choose, their general appraisal of the auction method of marketing may be an important factor in determining the probable future of such auctions. Probably the best way to learn the attitudes of growers towards auctions is to find out what use they actually have made of them.

To determine the relative use of auctions by growers, data were obtained from 431 growers, 128 of whom were located in 4 northern States, and 303 in 6 southern States (figure 9). Every effort was made to obtain data from a sufficient number of growers in the vicinity of each auction to reflect the general attitude of growers toward auction marketing as accurately as possible.

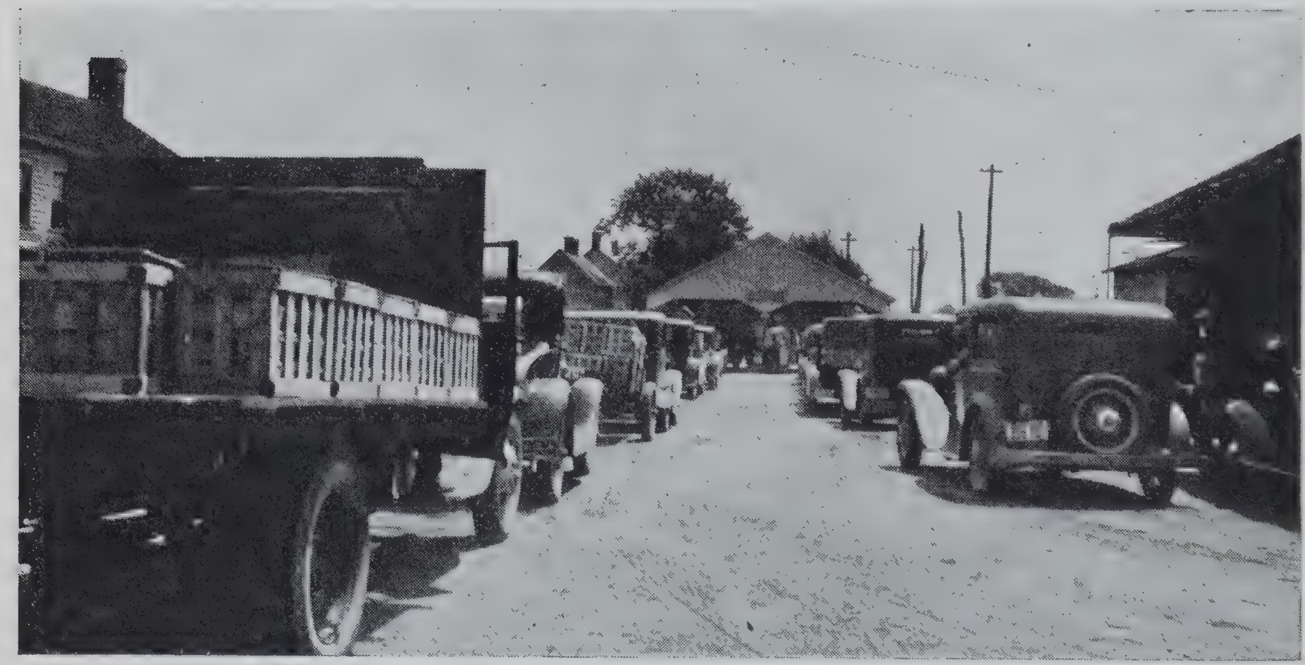

FIGURE 9. SCENE AT PITTSVILLE, MARYLAND, AUCTION, SHOWING LONG LINE OF GROWERS AWAITING TURN TO SELL PRODUCE AT THE AUCTION

DISTANCE TO AUCTIONS

One of the purposes of this study was to learn the extent to which the auction method of sale was used by growers within areas actually served by auctions.

The size of the area served was not identical for any two auctions. A 10-mile radius was arbitrarily selected as the maximum, within which it would be reasonable to assume that all growers producing commodities (which might have been sold at auction) could have used such an auction. Some auctions did not serve an area as large as that included in a 10-mile radius. Under such conditions, only growers whose farms were located within the small area, which such an auction could have served, were included. Because of the overlapping of auction territories, a few of the growers were located more than 10 miles from the auction which they patronized. For example, a grower located within 10 miles of one auction might not have had any of the commodities which were handled by the nearest auction, and might, therefore, have patronized a second auction located more than 10 miles from his farm.

Approximately 60 per cent of these growers lived less than 4 miles from auctions handling some commodity they sold during 1936 (table 20). About 18 per cent were located one mile distant; about 25 per cent, 2 miles; and another 18 per cent, 3 miles from the auctions. About one-third of all these growers lived from 4 to 7 miles from the auctions at which they sold some commodity or commodities during 1936.

TABLE 20. RELATIVE DISTANCE FROM FARM TO AUCTION, AS REPORTED BY 431 GROWER-PATRONS, 10 EASTERN SEABOARD STATES, 1936

Distance to nearest auction*	Growers in group	Proportion of growers so located
Miles	*Number*	*Per cent*
1	76	17.6
2	109	25.4
3	76	17.6
4	74	17.2
5	36	8.4
6	20	4.6
7	14	3.2
8	5	1.2
9	4	0.9
10	7	1.6
11	4	0.9
12	3	0.7
13	3	0.7
Total	431	100.0

*Which handled one or more commodities sold by the grower.

VOLUME OF SALES

The average sales of fruits and vegetables by these 431 growers amounted to about $2600 per grower in 1936. About 50 per cent of these growers reported fruit and vegetable sales of less than $1500 per grower, and only 12 per cent sold more than $5000 worth in 1936.

Growers in northern States averaged approximately $3500 each in volume of fruit and vegetable sales during 1936. Growers in southern States averaged less than $2200 each for such sales.

COMMODITIES SOLD AT AUCTIONS

Of 431 growers, 375, (or 81 per cent) sold some fruits and vegetables at country auctions in 1936. Their total sales at auction exceeded $350,000, or about $950 per grower. A little more than $140,000 of this total volume, or about $1457 per grower, was sold by 96 growers in the 4 northern States; and about $216,000, or about $739 per grower, by 279 growers in the 6 southern States (table 21).

Strawberries were the most important commodity sold, making up about 18 per cent of the total value of all commodities sold at auction by these growers in 4 northern States, and about 50 per cent in 6 southern States.

String beans, Irish potatoes, lima beans, cantaloupes, cauliflower, and cucumbers, in the order mentioned, were next in importance. Irish potatoes and cauliflower were much more important in northern States than in southern States; string beans, cantaloupes, and cucumbers were more important in southern States than in northern States. Together with strawberries, these six commodities made up nearly 80 per cent of the total value of all fruits and vegetables sold at auction by the 375 growers.

RELATIVE USE OF AUCTIONS

In the 4 northern States, 96 growers (about 75 per cent) sold some produce at country fruit and vegetable auctions during 1936; and in the 6 southern States, 279 growers (about 92 per cent made use of auctions.[11]

TABLE 21. LEADING COMMODITIES SOLD AT AUCTION, AS REPORTED BY 375 GROWERS, 10 EASTERN SEABOARD STATES, 1936*

Commodity	Total auction sales in			Proportion of total auction sales in		
	4 northern States	6 southern States	Total	4 northern States	6 southern States	Total
	Dollars	*Dollars*	*Dollars*	*Per cent*	*Per cent*	*Per cent*
Strawberries	23,432	108,399	131,831	18	50	38
String beans	5,992	27,681	33,673	4	13	9
Irish potatoes	17,278	12,925	30,203	12	6	8
Lima beans	9,047	12,984	22,031	6	6	6
Cantaloupes	637	20,481	21,118	‡	10	6
Cauliflower	20,632	......	20,632	15	..	6
Cucumbers	812	15,860	16,672	1	7	5
Peaches	11,205	......	11,205	8	..	3
Green peppers	3,634	4,101	7,735	3	2	2
Tomatoes	5,703	1,643	7,346	4	1	2
Dry onions	7,143	......	7,143	5	..	2
Apples	5,597	......	5,597	4	..	2
Blackberries	4,850	......	4,850	3	..	1
Sweet potatoes	4,753	42	4,795	3	‡	1
Broccoli	537	3,212	3,749	‡	1	1
Dewberries	......	3,628	3,628	..	2	1
Green peas	769	2,772	3,541	1	1	1
Raspberries	3,099	......	3,099	2	..	1
Sweet corn	1,492	1,275	2,767	1	1	1
Cabbage	2,616	48	2,664	2	‡	1
Miscellaneous commodities†	11,452	962	12,414	8	‡	3
Total	140,680	216,013	356,693	100	100	100

*Commodities which made up one per cent or more of the total auction sales of all commodities in the 10 States.

†Includes all commodities not among the leading twenty; in order of importance they were: carrots, brussels sprouts, watermelons, beets, lettuce, eggplant, pears, grapes, radishes, parsley, spinach, squash, dandelion greens, cherries, holly wreaths, currants, green onions, okra, leeks, parsnips, chicory, celery, turnips, asparagus, scallions, and pumpkins.

‡Less than one per cent.

When *all* produce was considered, only 32 per cent of the fruit and vegetable sales reported by these 431 growers was disposed of at country auctions in 1936. The percentage sold was about the same in the northern and in the southern States. When, however, only those sales which could have been made at an auction within 10 miles of the farm were considered, the proportion sold by this method was 60 per cent in the South and 39 per cent in the North.

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[11] It should be borne in mind that data were obtained only from growers within areas actually served by country fruit and vegetable auctions, and within these areas, only from growers who raised some commodity of the kind handled by an auction within 10 miles of their farms. The proportion of growers in any area who actually sold fruits and vegetables at country auctions would, of course, be much lower were it not for these limitations. The limitations were necessary to determine the proportion of growers that might reasonably be expected to use country fruit and vegetable auctions, who were actually using them.

LENGTH OF SERVICE THROUGH AUCTIONS

The periods during which these 375 growers used auctions during 1936 ranged from 1 to 100 days, and averaged about 23 days. The 96 growers in 4 northern States patronized auctions about 35 days during the year. The 279 growers in 6 southern States used auctions an average of about 18 days during 1936.

GROWERS' ATTITUDES TOWARDS AUCTIONS

About 16 per cent of these 431 growers seemed to have had a highly favorable attitude toward auctions. The attitudes of a much larger proportion (58 per cent) might be classified as reasonably favorable; about 13 per cent seemed to be somewhat indifferent; and 13 per cent registered varying degrees of opposition to country auctions as a means for selling fruits and vegetables satisfactorily.

What growers think may be one thing, and what they do may be something else. Probably the best test of the attitudes of these growers is what they did during 1936. All the growers with "highly favorable" attitudes toward country auctions patronized them in 1936, as did about 97 per cent of the growers who had reasonably favorable attitudes. However, in spite of their attitudes, about two-thirds of the growers who were indifferent towards auctions actually patronized them; and approximately one-half of those who were opposed to auctions also used them to some extent. Growers with "highly favorable" attitudes towards auctions sold 47 per cent (in dollars) of their fruits and vegetables through auctions, while only 10 per cent of their fruit and vegetable sales were made through auctions by growers listed as "opposed".

DISTANCE FROM AUCTIONS

Distance growers lived from auctions likewise affected the proportion of growers selling at country auctions. Distances up to 5 miles did not seem to affect the proportion of growers selling at auction, since just as large a proportion (89 per cent) of growers living 5 miles away patronized the auctions as of those living less than 3 miles away (table 22). Distances of more than 7 miles, however (none farther than 13 miles), appreciably reduced the proportion of growers selling at auctions.

TABLE 22. DISTANCE FROM FARM TO NEAREST AUCTION* RELATED TO GROWERS' USE OF AUCTIONS, AS REPORTED BY 431 GROWERS, 10 EASTERN SEABOARD STATES, 1936

Distance to nearest auction	Growers interviewed	Growers who used auctions		Proportion of growers' total fruit and vegetable sales made at auction
			Percentage of total	
Miles	*Number*	*Number*	*Per cent*	*Per cent*
Less than 3	185	165	89	33
3–4.9	150	134	89	34
5–6.9	56	47	84	31
7 or more	40	29	72	22
Total or average	431	375	87	32

*Which handled one or more commodities the growers sold.

SIZE OF GROWER'S BUSINESS

It has been generally assumed that growers with large acreages made relatively little use of country fruit and vegetable auctions, and that one of the most acute problems confronting country auctions has been to develop services that would appeal to such growers.

If these assumptions are correct, the patronage of country auctions would have to consist largely of growers who are small operators. The facts indicate, however, that approximately as large a proportion (about 77 per cent) of the growers with 50 acres or more of fruits and vegetables in 1936 sold at country auctions, as did growers with less than 5 acres (78 per cent) (table 23). It was true, however, that the proportion of all produce which was sold at auction, decreased markedly as the size of the grower's business increased, but it is obvious that the volume marketed from only 18 per cent of 50 or more acres would be greater than the volume from 61 per cent of three acres. If these data are representative, it would seem that the patronage of growers operating on a large scale, therefore, was relatively more important to country auctions than that of growers whose business was small. Generally speaking, something over half of the patronage and income at these auctions came from growers with acreage above the average.

TABLE 23. RELATION OF SIZE OF GROWER'S BUSINESS, AS MEASURED BY ACRES OF FRUITS AND VEGETABLES GROWN, TO USE OF AUCTIONS, AS REPORTED BY 431 GROWERS, 10 EASTERN SEABOARD STATES, 1936*

Acreage of fruits and vegetables	Growers interviewed	Growers who used auction		Proportion of grower's total fruit and vegetable sales made at auction
			Percentage of total	
Acres	*Number*	*Number*	*Number*	*Per cent*
Less than 5	50	39	78	61
5– 9.9	113	96	85	47
10–14.9	72	66	92	47
15–24.9	88	82	93	32
25–49.9	78	69	88	33
50 or more	30	23	77	18
Total or average	431	375	87	32

*These 431 growers raised an average of about 20 acres of fruits and vegetables per grower in 1936. The 128 growers interviewed in 4 northern States raised an average of 27 acres, while the 303 growers in 6 southern States averaged only about 17 acres each.

When growers' operations were measured by their gross sales in dollars of fruits and vegetables in 1936, the same relationship was observed. A slightly higher percentage of growers, whose fruit and vegetable sales totaled $5000 or more, used country auctions, than of growers whose fruit and vegetable sales were less than $500 (table 24). On the other hand, sales at country auctions averaged 56 per cent of total sales by growers who sold less than $500 worth of fruits and vegetables, and only 22 per cent for the group whose total sales aggregated $5000 or more.

PLACE OF SALE

Total fruit and vegetable sales at all markets by these 431 growers amounted to $1,108,505. Of this total, about 32 per cent was sold at country auctions, about 30 per cent at small local markets other than country auctions, 23 per cent at the farm, and 15 per cent at large city markets.

TABLE 24. RELATION OF SIZE OF GROWER'S BUSINESS, AS MEASURED BY GROSS SALES OF FRUITS AND VEGETABLES, TO USE OF AUCTIONS, AS REPORTED BY 431 GROWERS, 10 EASTERN SEABOARD STATES, 1936

Range in gross sales of all fruits and vegetables	Growers interviewed	Growers who used auctions		Proportion of grower's total fruit and vegetable sales made at auction
			Percentage of total	
Dollars	*Number*	*Number*	*Per cent*	*Per cent*
Less than 500	77	64	83	56
500– 999	63	53	84	53
1,000–1,499	78	68	87	52
1,500–2,499	68	62	91	45
2,500–4,999	90	80	89	32
5,000 or more	55	48	87	22
Total or average	431	375	87	32

Gross sales per grower averaged $1483 at the farm, $1321 at other small local markets, $1061 at large city markets, and $951 per grower at auctions.

Of the total fruits and vegetables sold by the 431 growers in 1936, not more than 64 per cent could have been sold at auctions within a reasonable distance of the farm. Of the portion which could have been sold at auction within a reasonable distance, about half was actually sold at auction (table 25). The average proportion of total volume sold at auctions (60 per cent), and at local markets (23 per cent) in the southern States was considerably greater than in the northern States, where much larger percentages were sold at large city markets (33 per cent), and at the farm (19 per cent).

TIME SPENT SELLING AT AUCTIONS

The 375 growers who patronized auctions spent, on the average, a little less than an hour selling a load of produce at auction from the time they left their farms until they returned. In the northern States, the average was about an hour and a quarter, and in the southern States about 50 minutes.

About 12 per cent of the southern growers spent as little as 15 minutes, and about a third spent only 30 minutes in selling a load at auction. More than four-fifths of the growers in the southern States required an hour or less to sell at auction. In the northern States, about 62 per cent spent an hour or less, and about 38 per cent more than an hour.

Comment that the time required to sell a load at auction was excessive came mostly from growers in New Jersey. On the average, nearly an hour and a half was spent selling a load at auction in this State, and growers reported that it was often necessary to spend three hours at some of the larger auctions.

WHY GROWERS USED AUCTIONS

Approximately 58 per cent of the 375 growers indicated that "higher net returns" was the major reason why they used auctions (table 33, appendix). Nearly one-fifth of the growers indicated that, in their localities, the auction was the "only practical or reasonable method of sale available;" about 14 per cent were of the opinion that there was "less risk in selling"

TABLE 25. PLACE OF SALE OF ALL FRUITS AND VEGETABLES,* AS REPORTED BY 431 GROWERS, 10 EASTERN SEABOARD STATES, 1936

Place of sale	Proportion of total fruit and vegetable sales									
	Massachusetts, Connecticut, and New York combined	New Jersey	4 northern States	Delaware	Maryland	Virginia	North Carolina	South Carolina and Florida combined	6 southern States	Total 10 States
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Country fruit and vegetable auctions..	50	34	39	90	82	34	61	58	60	50
Local markets other than country auctions..........................	6	11	9	2	2	48	12	41	23	16
Large city markets.................	13	41	33	4	13	10	21	1	12	22
At farm..........................	31	14	19	4	3	8	6	..	5	12
Total........................	100	100	100	100	100	100	100	100	100	100

*Which might possibly have been sold at some auction within 10 miles of farm.

at auctions; and about one-eighth preferred to use auctions because they "see their own produce sold, and know what they get when they sell."

WHY GROWERS DID NOT USE AUCTIONS

Of the 56 growers who did not sell at auction in 1936, more than half gave "lower net returns than other methods of sale available" as the reason; and about one-fifth said that auctions were "less convenient than other methods of sale available." Another one-fifth had a "dislike of auction owners, buyers or personnel;" and nearly one-fifth were "reluctant to change from present method of sale." Slightly more than 10 per cent of these growers explained that they "did not have enough produce to bother hauling to auction," and about the same percentage that "auctions cannot handle produce in large lots."

USE OF AUCTIONS BY BUYERS

If these auctions are to be successful, they must be able to induce a sufficient number of buyers to patronize the auction consistently so as to insure competitive bidding. To do this effectively, the wishes and requirements of buyers must be known and met insofar as it is practicable. For this reason, data were obtained directly from 114 auction buyers who made purchases at 62 of the 64 auctions. Whenever possible, at least three buyers at each auction were included (figure 10).

About 31 per cent of these buyers made purchases at only one auction, 17 per cent at two auctions, 12 per cent at three, 13 per cent at four, and about 27 per cent at five or more auctions. On the average, these buyers

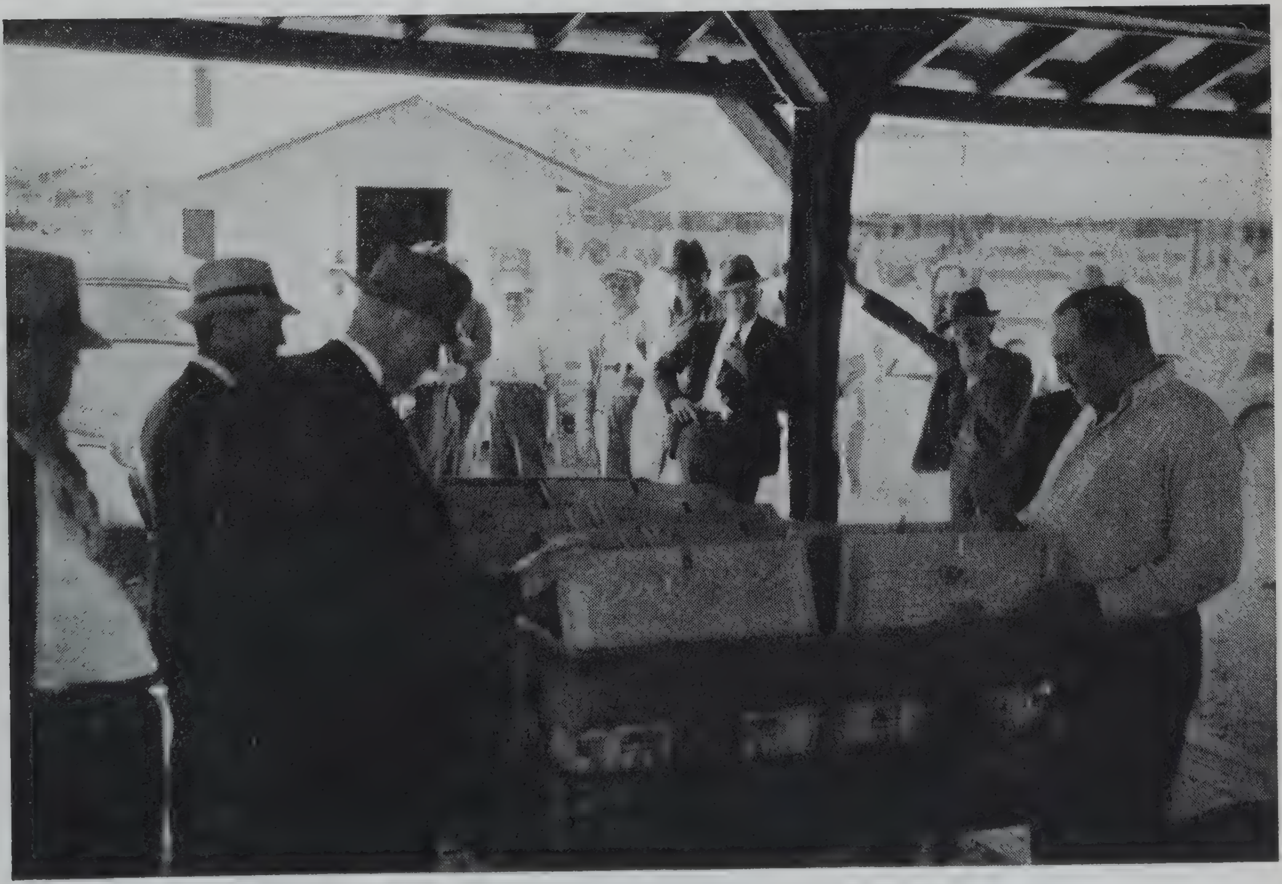

Figure 10. SCENE AT CHADBOURN, NORTH CAROLINA, AUCTION
Buyers from North Carolina, Maryland, and New Jersey inspecting offering of strawberries

made purchases at four auctions in 1936. The maximum number of auctions patronized by any northern buyer was five, and by any southern buyer, fourteen.

LOCATION OF BUYERS

Of the 114 buyers interviewed, 83 per cent had temporary or permanent headquarters within a mile of the nearest auction they patronized in 1936. Only 10 were as far as two miles, and only 9 buyers were located three miles or more from the nearest auction.

VOLUME OF BUSINESS FROM ALL SOURCES

The total fruit and vegetable purchases by these buyers from all sources approximated about 12 million dollars during 1936. About 9 per cent of these buyers made annual purchases totaling more than $200,000 per buyer, but 58 per cent purchased less than $50,000 worth per buyer (table 34, appendix). The average total purchases of fruits and vegetables per buyer in the northern States were approximately $48,000, and in the southern States about $112,700.

PROPORTION OF TOTAL PURCHASES AT AUCTION

Approximately 12 per cent of these buyers bought all of their fruit and vegetable supplies at auction, and about one-third estimated that they bought 80 per cent or more at auction. On the other hand, 17 per cent of the buyers estimated that they purchased less than 40 per cent of their total dollar volume of fruits and vegetables at auction.

TYPES OF BUYERS

More than three-fourths of these 114 auction buyers were country dealers. Of the remainder, 15 were merchant truckers, 7 were city wholesalers or jobbers, 3 were representatives of commission houses, one was a retailer, and one represented a cannery.

Representatives of city commission houses estimated that they obtained at auction 71 per cent of the total fruit and vegetables they purchased; merchant truckers and city jobbers or wholesalers, slightly more than two-thirds; country dealers, about 58 per cent; the retailer, about 48 per cent; and the cannery buyer, 10 per cent.[12] Average auction purchases per buyer were nearly $60,000, or about 58 per cent of total purchases per buyer (table 26).

OWNERSHIP RELATIONS OF BUYERS WITH AUCTIONS

About a third of the 114 buyers were part owners of one or more auctions in 1936, and another 5 per cent were full owners of one or more auctions. Those buyers who were neither owners nor part owners of any auction, bought about one-half of their total dollar volume of fruits and vegetables at auction. Those who were part owners of auctions bought about 72 per cent of their total fruit and vegetable purchases at auction; but those who

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[12] These percentage figures may be somewhat exaggerated. Since a large number of these buyers were full or part owners of auctions, they may have overestimated the proportion of their total purchases which was made at auctions.

TABLE 26. RELATION OF TYPE OF BUYER TO PROPORTION OF TOTAL FRUIT AND VEGETABLE PURCHASES AT COUNTRY AUCTIONS, AS REPORTED BY 114 BUYERS, 10 EASTERN SEABOARD STATES, 1936

Type of buyer	Buyers in group	Total purchases per buyer	Auction purchases per buyer	Proportion of total purchases at auction*
	Number	*Dollars*	*Dollars*	*Per cent*
Country dealer	87	114,988	66,296	58
Merchant trucker	15	41,974	28,593	68
City jobber or wholesaler	7	59,781	39,915	67
Commission-house representative	3	89,188	62,981	71
Retailer	1	6,466	3,105	48
Cannery	1	174,400	16,650	10
Average per buyer		101,913	59,447	58

*See footnote 12.

were full owners bought only about 41 per cent of their total purchases at auction.

BUYERS' ATTITUDES TOWARD AUCTIONS

About 89 per cent of these buyers seemed to have a favorable attitude toward auctions, about 8 per cent appeared somewhat indifferent, and 3 per cent were opposed. Most of the buyers who were indifferent or opposed were in New Jersey, Delaware, and Maryland.

DISTANCE BUYERS TRAVELED TO AUCTIONS

About 55 per cent of these 114 buyers traveled less than 25 miles to the most distant auction they patronized in 1936. The average for this group was only 6 miles, but about 19 per cent traveled an average of about 520 miles to the most distant auction at which they made purchases in 1936. The range in distance traveled was from 1 to 1085 miles.

The maximum number of miles traveled to the most distant auction by any buyer in the northern States was 105 miles. The maximum traveled by any buyer in Delaware was 970 miles; Maryland, 975 miles; South Carolina, 650 miles; and Florida, 1085 miles. Many Delaware, Maryland, and Virginia buyers went as far south as North Carolina to buy strawberries at country auctions, and a few patronized the auction at Wauchula, Florida.

The principal reason given by these buyers for traveling such long distances to country auctions was that they were able to obtain more advantageous terms from city wholesalers for midseason and late crops, if they supplied the wholesalers with early strawberries and other commodities from the southern States when the wholesalers were in greatest need of them. Most of the buyers insisted that they made very little profit handling early produce, but that it was necessary to do so if they wished to do business for the remainder of the year with city wholesalers. For such buyers, country auctions were the most convenient places to buy this early produce.

For buyers who traveled more than 25 miles to the most distant auction used, the greater the distance traveled, the greater the proportion of total fruit and vegetable supplies bought at auction. The group which traveled less than 25 miles to the most distant auction, however, bought about 55 per cent of their total fruit and vegetable supplies at country auctions, or a larger proportion than any except the group that traveled 200 miles or more. Buyers located within a mile of the nearest auction, which meant in nearly all cases that the buyer's place of business was at the same shipping point and usually very close to the auction, obtained about 59 per cent of their total fruit and vegetable purchases at auction.

SIZE OF BUYER'S BUSINESS

The relation of size of business to proportion of total fruit and vegetable purchases at auction was not entirely consistent. As the size of the business increased from less than $25,000 up to $150,000, the proportion of total purchases at auction increased from about 62 per cent to 72 per cent. For buyers whose total fruit and vegetable purchases exceeded $150,000, however, the proportion bought at auction declined to slightly more than 50 per cent.

PLACE OF PURCHASE

Only buyers who actually bought produce at some auction were included in this survey. Total fruit and vegetable purchases at all markets by those 114 buyers amounted to $11,618,118. Of this total, about 58 per cent was estimated to have been bought at country auctions, about 33 per cent at other small local markets, 9 per cent at the farm, and less than one per cent at city markets.

Of the total fruits and vegetables purchased by these 114 buyers in 1936, not more than 60 per cent could have been bought at auction within a reasonable distance of the buyer's place of business. Of the portion which could have been bought at auction within a reasonable distance, about 85 per cent was actually so purchased. Approximately 11 per cent was bought at small local markets other than country auctions, about 4 per cent at the farm, and only about one-tenth of one per cent at city markets. The proportion bought by northern buyers at small local markets other than auctions, at the farm, and at city markets was more than twice as large as the proportion purchased by southern buyers at these places.

COMMODITIES PURCHASED AT AUCTIONS

The 114 buyers reported total fruit and vegetable purchases at country auctions of nearly 7 million dollars in 1936. A little less than $6,200,000[13] of this total volume was estimated to have been bought at country auctions in southern States, and nearly $600,000 at auctions in northern States (table 27). Strawberries made up nearly 64 per cent, cantaloupes about 10 per cent, cucumbers about 9 per cent, and string beans about 7 per cent of the total value of all commodities purchased at auction by these buyers. No other commodity represented more than 3 per cent of the total. Cantaloupes were much more important in the southern than in the northern States; cucumbers and string beans were more important in northern

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[13] Since only about six million dollars worth of fruits and vegetables were sold by all southern auctions in 1936, it seems clear that the 114 buyers overestimated their auction purchases. Since 87 of these 114 auction buyers were local country dealers, and from 600 to 700 other buyers bought through these local buyers, however, it seems logical that a small number of buyers could account for a large share of the southern auctions' business.

States than in Southern States. These three commodities, together with strawberries, made up nearly 90 per cent of the gross purchases of all fruits and vegetables bought at country auctions by these 114 buyers.

PURCHASES BY EACH TYPE OF BUYER

Data obtained from the 64 auctions indicate that of the total sales at all auctions (totaling about 8.6 million packages of fruits and vegetables), about 40 per cent was to local country dealers, about 13 per cent to country dealers from other shipping points, 29 per cent to merchant truckers, 14 per cent to city wholesalers, jobbers, or their representatives, 3 per cent to buyers for canneries, juice plants, or wineries, and about one per cent to all other types of buyers (table 28).

TABLE 27. RELATIVE IMPORTANCE OF TWENTY-TWO LEADING COMMODITIES PURCHASED AT COUNTRY AUCTIONS BY 114 BUYERS, 10 EASTERN SEABOARD STATES, 1936*

Commodity	Total fruit and vegetable purchases at auction			Proportion of total fruit and vegetable purchases made at auction		
	4 northern States	6 southern States	Total	4 northern States	6 southern States	Total
	Dollars	*Dollars*	*Dollars*	*Per cent*	*Per cent*	*Per cent*
Strawberries	119,000	4,183,637	4,302,637	20.1	67.7	63.5
Cantaloupes	5,600	652,199	657,799	0.9	10.5	9.7
Cucumbers	76,665	511,924	588,589	12.9	8.3	8.7
String beans	55,595	399,665	455,260	9.4	6.5	6.7
Tomatoes	31,257	175,250	206,507	5.3	2.8	3.0
Lima beans	31,325	133,010	164,335	5.3	2.2	2.4
Cauliflower	86,800	....	86,800	14.6	....	1.3
Sweet potatoes	47,100	....	47,100	7.9	....	0.7
Green peppers	26,600	16,670	43,270	4.5	0.3	0.6
Dewberries	....	33,000	33,000	....	0.5	0.5
Raspberries	25,175	....	25,175	4.2	....	0.4
Green peas	3,290	21,220	24,510	0.6	0.4	0.4
Blackberries	13,217	8,512	21,729	2.2	0.1	0.3
Sweet corn	2,716	18,360	21,076	0.5	0.3	0.3
Peaches	18,520	165	18,685	3.1	†	0.3
Dry onions	14,400	....	14,400	2.4	....	0.2
Apples	10,800	272	11,072	1.8	†	0.2
Irish potatoes	5,665	5,060	10,725	1.0	0.1	0.2
Broccoli	495	7,800	8,295	0.1	0.1	0.1
Eggplant	2,000	6,000	8,000	0.3	0.1	0.1
Brussels sprouts	5,300	....	5,300	0.9	....	0.1
Squash	425	3,950	4,375	0.1	0.1	0.1
Miscellaneous commodities‡	11,195	7,157	18,352	1.8	0.1	0.3
Total, all commodities	593,140	6,183,851	6,776,991	100.0	100.0	100.0

*All commodities which made up one-tenth of one per cent or more of total purchases at country auctions.

†Less than one-tenth of one per cent.

‡Includes cabbage, pears, huckleberries, cherries, lettuce, carrots, watermelons, beets, celery, spinach, romaine, dandelion greens, pumpkins, turnips, fava beans, okra, and miscellaneous fruits and vegetables.

Except for apples, peaches, and raspberries, country dealers handled a relatively large share of nearly all commodities. Merchant truckers bought relatively small quantities of strawberries, string beans, lima beans, green peas, and dewberries. They constituted the largest single outlet for raspberries, sweet potatoes, apples, peaches, blackberries, and Irish potatoes. Canneries, juice plants, or wineries bought only three commodities: tomatoes, strawberries, and dewberries.

TABLE 28. PROPORTION OF TOTAL VOLUME OF TWENTY LEADING COMMODITIES SOLD TO EACH TYPE OF BUYER,* 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS 10 EASTERN SEABOARD STATES, 1936

Commodity	Proportion of total volume sold to each type of buyer					
	Local country dealers	Country dealers from other shipping points	Merchant truckers	City wholesalers, jobbers, or their representatives	Buyers for canneries, juice plants, or wine factories	All other buyers†
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Tomatoes	40	4	30	5	20	1
Strawberries	38	32	15	14	1	‡
String beans	49	19	16	16	..	‡
Cucumbers	47	14	26	13	..	‡
Cantaloupes	44	24	20	12	..	‡
Cauliflower	30	..	31	39	..	‡
Green peppers	46	11	36	7	..	‡
Lima beans	53	13	17	17	..	‡
Sweet potatoes	22	..	74	3	..	1
Green corn	39	7	31	18	..	5
Apples	9	..	64	16	..	11
Peaches	15	..	64	19	..	2
Onions, dry	68	..	21	10	..	1
Watermelons	45	..	26	23	..	6
Green peas	52	14	17	16	..	1
Irish potatoes	29	‡	55	12	..	4
Eggplant	49	6	27	17	..	1
Dewberries	26	52	13	4	5	..
Raspberries	1	..	86	11	..	2
Blackberries	37	..	63	..	..	..
Miscellaneous commodities§	40	1	53	3	..	3
Total, all commodities	40	13	29	14	3	1

*Commodities which make up one per cent or more of either the total number of packages or the total gross value of all commodities sold at auction in 1936.

†Includes retailers, hotels, restaurants, hucksters, and consumers.

‡Less than one per cent.

§Includes all commodities sold at auction other than the leading twenty listed in the table.

METHODS OF SALE USED BY AUCTION BUYERS

In terms of dollar volume, about 36 per cent of all commodities purchased at auction by the 114 auction buyers was shipped to city commission merchants on consignment; about 30 per cent was sold to city wholesalers or jobbers on a delivered-at-market basis; about 15 per cent, to city wholesalers on order (f. o. b. country points); 6 per cent, to other country dealers at auction or other country points; 5 per cent, to merchant truckers at auction or other country points; 5 per cent, to city wholesalers on joint-account; 2 per cent, to canneries or juice plants; 1 per cent was delivered to retailers, hucksters, hotels, and restaurants; and less than 1 per cent was sold directly to consumers (table 35, appendix).

There was much variation between commodities as to method of sale. Approximately half or more of the onions, sweet potatoes, blackberries, dewberries, watermelons, green peppers, and green corn were shipped to city commission merchants on consignment. On the other hand, about two-thirds of the peaches and raspberries, and approximately one-half of the watermelons, cauliflower, and blackberries were sold to city wholesalers or jobbers f. o. b. the market. Three-fourths of the eggplant and one-half of the cucumbers were sold to city wholesalers on order (f. o. b. country points).

PLACES OF SALE USED BY AUCTION BUYERS

Approximately 25 per cent of the total dollar volume of all commodities sold by these 114 auction buyers went to New York City; about 18 per cent to upstate New York markets; 17 per cent to other New England markets; 15 per cent to southern markets; 9 per cent to Boston; 7 per cent to Pennsylvania cities other than Philadelphia; 4 per cent to Philadelphia; another 4 per cent to western markets; and one per cent to New Jersey markets.

New York City was the outstanding market for eggplant, raspberries, apples, dewberries, peaches, and blackberries, but it should be noted that the distribution of nearly all of the twenty leading commodities was over a relatively wide area.

OPINIONS OF BUYERS AS TO EFFECTS OF AUCTIONS

Changes in areas of distribution

The 114 auction buyers were asked to express an opinion as to whether country auctions had had any effect on changes in areas of distribution in recent years. Of the 97 buyers who replied affirmatively, about 82 per cent were of the opinion that auctions brought in more distant buyers which automatically widened the distribution of fruits and vegetables from the area.

Grading and packaging

In answer to the question, "Have country produce auctions had any effect on the grading of any commodities sold through them?", 81 of the 114 buyers (about 71 per cent) answered "yes"; thirty (about 26 per cent) answered "no"; and three gave no answer. Of the 81 buyers who answered "yes", all but two thought auctions had helped grading.

When asked the question, "Have country auctions been responsible for bring about any changes in packaging of any commodities sold through them?", about 30 per cent of the 114 buyers replied in the affirmative; but about 65 per cent answered negatively. Of the 34 growers who replied affirmatively, 14 thought auctions had caused more standardized packaging, and 9 thought auctions were responsible for more uniform packaging.

New buyers

In answer to the question, "Have country auctions attracted you to any producing areas where you had not bought in appreciable quantities before?", nearly 60 per cent of the 114 buyers answered "yes", and about 40 per cent answered "no".

Means of transportation

Of the 114 buyers, 88 were of the opinion that auctions caused more produce to move to market by motor truck than would otherwise have been the case, because auctions made it easier for merchant truckers to get loads. Most of the auction managers, owners, and grower-patrons also thought auctions helped movement by motor truck.

Prices paid

In answer to the question, "What effect have country auctions had on prices which you were required to pay to growers for commodities?", 86 of the 114 buyers (about 75 per cent) were of the opinion that the auctions had increased prices they had to pay, and only one thought auctions had decreased prices. About 20 per cent thought auctions had no effect on the prices they had to pay.

APPENDIX

TABLE 29. LOCATION OF 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS WHICH OPERATED IN 10 EASTERN SEABOARD STATES DURING 1936

Location of auction

- Massachusetts:
  - Boston Regional Market
- Connecticut:
  - Manchester
  - New Haven City Market
- New York:
  - Highland
  - Riverhead, L. I.
- New Jersey:
  - Hightstown
  - Beverly
  - Swedesboro
  - Glassboro
  - Hammonton
  - Landisville
  - Vineland
  - Rosenhayn
  - Cedarville
- Delaware:
  - Bridgeville
  - Seaford
  - Millsboro
  - Laurel
  - Selbyville
  - Delmar
- Maryland (Eastern Shore Section):
  - Federaldsburg
  - Pittsville
  - Salisbury
  - Berlin
  - Fruitland
  - Allen
  - Princess Anne*
  - Pocomoke City
  - Marion Station

Location of auction

- Virginia (Eastern Shore Section):
  - Oak Hall Station
  - Atlantic
  - Temperanceville
  - Hallwood
  - Nelsonia
  - Bloxom
  - Hopeton
  - Parksley
  - Onley
  - Melfa
  - Keller
  - Painter
  - Craddockville
  - Exmore*
  - Nassawadox
  - Machipongo
  - Bayview
- North Carolina:
  - Goldsboro
  - Cameron
  - Vass
  - Mount Olive
  - Calypso
  - Faison
  - Warsaw
  - Turkey
  - Rose Hill
  - Wallace
  - Burgaw
  - Chadbourn
  - Tabor City
- South Carolina:
  - Loris
  - Lake City
- Florida:
  - Wauchula

*Two auctions operated at Princess Anne, Maryland; and two at Exmore, Virginia.

TABLE 30. APPROXIMATE NUMBER OF PACKAGES OF FRUITS AND VEGETABLES SOLD THROUGH COUNTRY AUCTIONS IN 10 EASTERN SEABOARD STATES, 1911–1936

(Data are in thousands of packages, 000 omitted)

Year	New York	New Jersey	Massachusetts	Connecticut	4 northern States	Delaware	Maryland	Virginia	North Carolina	South Carolina	Florida	6 southern States	Total 10 States
1911	...	....	..	...	....	....	10	...	....	...	...	10	10
1912	55	....	..	...	55	....	13	8	....	...	...	21	76
1913	100	....	..	...	100	....	18	14	....	...	...	32	132
1914	140	....	..	...	140	....	25	15	....	...	...	40	180
1915	145	....	..	...	145	....	30	16	8	...	...	54	199
1916	160	....	..	...	160	....	35	17	12	...	...	64	224
1917	175	....	..	...	175	....	40	18	15	...	...	73	248
1918	165	....	..	...	165	....	45	34	18	...	...	97	262
1919	190	....	..	...	190	....	50	43	20	...	...	113	303
1920	200	....	..	...	200	55	120	53	60	...	...	288	488
1921	240	....	..	...	240	60	160	63	95	...	...	378	618
1922	268	....	..	...	268	65	205	73	205	...	...	548	816
1923	293	....	..	...	293	70	215	80	295	...	...	660	953
1924	242	....	..	...	242	110	240	92	310	...	...	752	994
1925	373	....	..	...	373	185	300	104	382	...	...	971	1,344
1926	458	....	..	...	458	210	340	120	470	8	...	1,148	1,606
1927	245	....	..	...	245	235	345	137	525	12	...	1,254	1,499
1928	332	161	..	...	493	300	371	149	570	14	...	1,404	1,897
1929	179	290	..	...	469	335	434	222	640	16	...	1,647	2,116
1930	53	641	..	...	694	370	488	239	673	18	...	1,788	2,482
1931	203	1,197	..	...	1,400	510	545	250	875	20	...	2,200	3,600
1932	273	1,444	..	8	1,725	590	586	281	1,016	47	...	2,520	4,245
1933	279	2,139	..	30	2,448	720	639	351	1,241	89	...	3,040	5,488
1934	542	2,461	..	66	3,069	870	691	392	1,402	102	90	3,547	6,616
1935	641	2,980	25	100	3,746	1,041	874	472	1,495	153	185	4,220	7,966
1936	861	3,125	51	144	4,181	1,158	879	498	1,300	198	395	4,428	8,609

TABLE 31. SOURCES OF GROSS INCOME, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Item	Proportion of gross income									
	Massachusetts, Connecticut, and New York combined	New Jersey	4 northern States	Delaware	Maryland	Virginia	North Carolina	South Carolina and Florida combined	6 southern States	Total 10 States
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Auction fees paid by growers	98.9	94.8	96.1	37.4	35.7	31.4	68.4	61.6	49.7	66.2
Auction fees paid by buyers	....	4.4	3.1	....	....	49.1	6.0	9.5	10.4	7.8
Brokerage fees paid by outside buyers	....	....	....	62.3	64.3	19.5	25.6	26.4	39.6	25.5
Other income	1.1	0.8	0.8	0.3	....	....	....	2.5	0.3	0.5
Gross income	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Item	Proportion of total expense									
	Massachusetts, Connecticut, and New York combined	New Jersey	4 northern States	Delaware	Maryland	Virginia	North Carolina	South Carolina and Florida combined	6 southern States	Total 10 States
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Personnel:										
Auctioneer	29.3	14.6	18.4	43.8	44.8	28.2	26.4	18.1	28.9	22.7
Manager	11.7	16.1	14.9	....	7.5	8.3	5.3	3.7	5.5	11.1
Inspectors	....	6.4	4.8	....	....	....	36.0	8.9	20.7	11.1
Auction clerk	9.2	7.1	7.6	16.8	22.2	12.3	4.1	12.9	9.4	8.3
Office clerks	9.1	11.0	10.5	5.6	3.4	8.9	1.8	1.7	3.1	7.6
Other employees	6.6	12.2	10.7	4.9	4.9	27.0	5.4	12.4	9.2	10.2
Employees' liability insurance	....	0.9	0.7	....	....	*	....	....	*	0.4
Total	65.9	68.3	67.6	71.1	82.8	84.7	79.0	57.7	76.8	71.4
Property:										
Interest on investment @ 5 per cent	2.4	5.3	4.6	8.8	0.9	0.6	0.4	21.4	4.0	4.3
Repairs and construction	5.4	4.2	4.6	1.8	5.1	1.2	2.0	0.2	2.0	3.6
Depreciation on buildings	2.8	2.0	2.2	8.5	1.5	1.2	1.2	10.9	3.1	2.5
Rent	6.4	0.2	1.8	2.7	1.5	2.5	2.2	....	1.9	1.8
Insurance	0.6	0.9	0.8	0.2	....	....	0.1	7.3	1.0	0.9
Taxes	0.6	0.9	0.8	1.1	0.4	0.3	....	....	0.1	0.5
Depreciation and purchase of equipment	0.4	0.7	0.6	....	....	....	0.1	....	*	0.4
Total	18.6	14.2	15.4	23.1	9.4	5.8	6.0	39.8	12.1	14.0
Supplies and services:										
Office supplies	3.5	4.8	4.6	0.9	0.8	0.9	0.4	0.2	0.5	2.9
Bank service	....	....	....	....	....	....	6.4	0.1	3.5	1.4
Auction supplies	0.6	0.1	0.2	....	0.4	0.9	4.5	1.0	2.7	1.2
Telephone and telegraph	1.8	1.5	1.6	2.0	1.1	0.6	0.6	0.4	0.7	1.2
Light and heat	0.4	0.6	0.5	....	3.0	....	0.7	0.2	0.8	0.7
Other	....	0.3	0.2	....	....	....	0.4	....	0.2	0.2
Total	6.3	7.3	7.1	2.9	5.3	2.4	13.0	1.9	8.4	7.6
Miscellaneous expense:										
Miscellaneous operating expense	2.0	5.5	4.6	2.7	2.3	5.6	1.9	0.6	2.4	3.7
Traveling expense	3.6	1.9	2.3	....	....	1.2	0.1	....	0.2	1.5
Advertising and publicity	1.0	1.0	1.0	....	....	....	....	....	....	0.6
Bad debts	0.9	0.6	0.7	....	....	....	....	....	....	0.4
Interest on borrowed money	0.3	0.6	0.5	....	....	....	....	....	....	0.3
Miscellaneous office expense	0.4	0.3	0.3	0.2	0.2	0.3	....	....	0.1	0.2
Other	1.0	0.3	0.5	....	....	....	....	....	....	0.3
Total	9.2	10.2	9.9	2.9	2.5	7.1	2.0	0.6	2.7	7.0
Total expense	$3385	$5351	$4649	$446	$531	$326	$1786	$1976	$860	$1689

TABLE 33. WHY GROWERS USED AUCTIONS, AS REPORTED BY 375 GROWERS, 10 EASTERN SEABOARD STATES, 1936

Reason*	Proportion of growers reporting each reason in†		
	4 northern States	6 southern States	Total 10 States
	Per cent	*Per cent*	*Per cent*
Higher net returns than from other methods of sale available	56	59	58
Only practical or reasonable method of sale available	..	24	18
Less risk in selling (more sure of getting money)	14	14	14
See their own produce sold and known what they get when they sell.	14	11	12
Receive payment more promptly	7	9	9
Good way to dispose of "leftovers", or lots hard to sell by other methods of sale	10	7	8
Good way for small growers to sell who do not have enough to bother shipping	2	9	7
More convenient method of sale	7	4	5
Like the buyers who patronize auction	2	6	5
Saves time	17	..	4
More dependable method of sale (more certain that produce can be sold when it is harvested)	11	1	4
Can determine sooner when prices do not warrant harvesting any more of crop	..	3	2
Good way to dispose of small loads or mixed loads of produce	7	‡	2
Selling together at auction is a good way to foster cooperation among growers	8	‡	2
Establishes or holds up prices in producing area, and thus helps eliminate possibility of truckers driving down prices at farm	1	1	1
Less expensive than other methods of sale	4	‡	1
Local buyers that have always sold at auction now buy	1	1	1
Sold a little at auction to try it out	..	2	1

*The reasons listed here were arrived at by grouping and condensing the reasons actually stated by growers, according to the essential meaning or point of their statements.

†Percentages do not add to 100, because most growers mentioned more than one reason.

‡Less than one per cent.

TABLE 34. RANGE IN TOTAL VOLUME OF FRUIT AND VEGETABLE PURCHASES FROM ALL SOURCES, 114 BUYERS, 10 EASTERN SEABOARD STATES, 1936

Range in dollar volume of purchases	Buyers reporting		
	Average purchases per buyer		Percentage of total
Dollars	*Dollars*	*Number*	*Per cent*
Less than 25,000	15,716	15	13
25,000– 49,999	36,216	40	35
50,000– 74,999	62,377	16	14
75,000– 99,999	85,090	11	10
100,000–149,999	117,050	12	10
150,000–199,999	178,404	10	9
200,000 or more	481,108	10	9
Total or average	101,913	114	100

TABLE 35. METHOD OF SALE OF TWENTY LEADING COMMODITIES* BOUGHT AT COUNTRY AUCTIONS, AS REPORTED BY 114 BUYERS, 10 EASTERN SEABOARD STATES, 1936

Commodity	Proportion of total dollar volume sold by each method								
	City commission merchant on consignment	City wholesaler or jobber delivered (f.o.b. market)	City wholesaler on order f.o.b. country point	Other country dealers at auction or other country point	Merchant trucker at auction or other country point	To wholesaler on joint account	To cannery or juice plant	Delivered to retailers, hucksters, restaurants, and hotels	To consumers
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Tomatoes	16	23	1	2	23	..	34	1	†
Strawberries	38	33	9	6	5	6	2	1	..
String beans	36	22	23	7	8	4	..	†	..
Cucumbers	19	18	51	8	1	3	..	..	..
Cantaloupes	39	30	20	2	2	7	..	..	..
Cauliflower	28	45	9	..	6	..	..	12	..
Green peppers	48	31	1	12	8	..	..	..	..
Lima beans	30	25	28	9	6	2	..	..	..
Sweet potatoes	60	39	..	..	1	..	..	..	..
Green corn	44	35	8	1	5	..	..	5	2
Apples	17	33	2	..	7	..	..	25	16
Peaches	16	66	..	..	..	..	..	18	..
Onions	66	18	..	10	6	..	..	..	..
Watermelons	49	51	..	..	..	..	..	..	..
Green peas	32	21	27	7	12	1	..	..	..
Irish potatoes	23	33	20	2	2	..	..	15	5
Eggplant	13	6	76	..	5	..	..	..	..
Dewberries	54	29	2	..	15	..	..	..	..
Raspberries	39	59	..	..	..	..	..	2	..
Blackberries	54	44	..	..	†	..	..	2	..
Miscellaneous commodities‡	41	28	12	2	6	..	..	7	4
Total, all commodities	36	30	15	6	5	5	2	1	*

*Includes all commodities which made up one per cent or more of either the total number of packages or total gross value of all commodities sold at country auctions in 1936.

†Less than one per cent.

‡Includes all commodities other than the leading twenty listed in table.

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Some Facts Concerning Country Fruit and Vegetable Auctions in Eastern Seaboard States

Edwin W. Cake

FIRST COUNTRY FRUIT AND VEGETABLE AUCTION ESTABLISHED IN NORTHEAST, RIVERHEAD, LONG ISLAND, NEW YORK

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SUMMARY AND CONCLUSIONS

Data were obtained from 64 country fruit and vegetable auctions located in 10 Eastern Seaboard States (Massachusetts to Florida), and from 431 growers and 114 buyers who patronized these auctions. Twenty-seven of the auctions were cooperative and 37 private or municipal auctions. During 1936, 48 vegetables, 18 fruits, and 4 other commodities were sold through these auctions.

The growth of country fruit and vegetable auctions seems to have been encouraged by (1) the increased use of motor trucks; (2) surpluses of products available at country shipping points together with general increases in the production of truck crops; (3) the wide disparity between prices received by growers and the cost of distribution; (4) dissatisfaction on the part of growers with returns from sales through other outlets; (5) rivalry between villages or towns; (6) desire for cash sales on the part of growers; and (7) relatively low costs of operation.

On the basis of estimates by the United States Department of Agriculture, approximately 2.3 per cent of the total production of all fruits and vegetables in the 10 Eastern Seaboard States were sold at country fruit and vegetable auctions. For the 10 States as a whole, however, sales at these auctions included almost one-half of the strawberries, and about 40 per cent of the lima beans, cauliflower, and cantaloupes offered for sale in these States.

The average number of growers patronizing each auction daily was 160, and the range was from 15 to 400. The average number of buyers at each auction daily was 16, and the range was from 2 to 75. The average gross value of fruits and vegetables handled in 1936 was about $142,000 per auction. The range was from less than $2500 to slightly more than $600,000.

By most measures of size, auctions in northern States were larger than those in southern States. Cooperative auctions were larger than private or municipal auctions.

Factors, on which data could be obtained, that seemed to have had an important influence on the quantity of fruits and vegetables sold per auction were: (1) number and kind of commodities handled; (2) length of operating season; (3) distance to nearest competing auction; and (4) size of the area served.

About two-thirds of the auction income was from fees paid by growers, about one-fourth from brokerage fees paid by outside buyers, and about 8 per cent from auction fees paid by buyers. Auction fees paid by growers ranged from 0.14 to 5.13 cents, and averaged about two cents per dollar of sales at the 60 auctions making such charges.

The range in total expenses per dollar of sales for all auctions was from one-tenth of one cent to 5.15 cents, and averaged about 1.2 cents per dollar of sales. Factors which seem to have had important influence on the total expenses per dollar of sales for the 64 auctions in 1936 were: (1) volume of sales per auction; (2) number of commodities handled; (3) length of operating season; (4) efficiency in the use of labor; and (5) type of ownership.

Some of the factors which seemed to influence the extent to which a grower used the auction were: (1) distance from his farm to the auction; (2) the size of his business; and (3) his attitude towards auctions. Approximately 58 per cent of 375 growers, who sold at auction in 1936, indicated that "higher net returns" was the major reason why they used this method of sale.

Total fruit and vegetable purchases in 1936 by 114 auction buyers interviewed, averaged about $102,000 per buyer. Some of the factors which seemed to influence the extent a buyer used auctions were: (1) the type of buyer; (2) number of years he had been in the fruit and vegetable business; (3) whether or not he was the owner or part owner of the auction; (4) the buyer's attitude toward auctions; (5) distance of an auction from his place of business; and (6) the size of his business.

About 58 per cent of the total fruit and vegetable purchases of these 114 auction buyers was estimated to have been made at country auctions, about 33 per cent at small local markets other than country auctions, 9 per cent at the farm, and less than one per cent at city markets.

Of the total sales by all auctions, about 40 per cent was estimated by auction officials to have been made to local country dealers; about 13 per cent to country dealers from other shipping points; 29 per cent to merchant truckers; 14 per cent to city wholesalers, jobbers, or their representatives; 3 per cent to buyers for canneries, juice plants, or wine factories; and about 1 per cent to all other types of buyers.

In some States, country fruit and vegetable auctions were important outlets; in others they played a relatively minor role. They may become significant factors in the marketing of certain commodities in States like New York, where they were relatively unimportant in 1936.

The total number of country fruit and vegetable auctions will probably increase. Two or three which operated during 1936 have ceased to operate since then because they were located too close to larger and more successful auctions. Other auctions, which were unwisely established, will probably cease operations. However, at least six new auctions have been established during the same period, all of which are sufficiently distant from other auctions. The number of new auctions which are established on sound economical principles will probably exceed the number which fail.

The chances of success seem greatest where large volumes of relatively perishable vegetables and fruits are available in season, where no competing auction is located closer than 15 miles or more, where period of operation can be restricted to the season when large volumes may be handled daily, where minimum investments in physical equipment are made, and where maximum use can be made of hired personnel.

Individuals or groups of growers in northeastern States who are contemplating establishment of new country fruit and vegetable auctions will probably find it advantageous to proceed slowly and study carefully the auctions now operating in New Jersey, New York, Connecticut, and Massachusetts, before deciding upon local operations.

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SOME FACTS CONCERNING COUNTRY FRUIT AND VEGETABLE AUCTIONS IN EASTERN SEABOARD STATES[1]

E. W. CAKE

Although fruits and vegetables have been sold at city auctions in the United States for more than a century, country fruit and vegetable auctions on the Eastern Seaboard were unknown prior to 1911. Such country auctions increased slowly in number, and by 1927 there were only 20 in operation. Since that year, however, the number of such auctions has more than trebled, and many cooperative associations, growers, and dealers have evidenced intense interest in the possibilities of this method of marketing (table 1). In 1937, at the request of farmers' organizations and farmers' cooperative associations, the New York State College of Agriculture, in cooperation with the Cooperative Research and Service Division of the

TABLE 1. NUMBER OF COUNTRY FRUIT AND VEGETABLE AUCTIONS, AND ESTIMATED VOLUME OF SALES, 10 EASTERN SEABOARD STATES, 1911–36*

Year	Auctions operating	Total sales	Sales per auction
	Number	*Packages*	*Packages*
1911	1	10,000	10,000
1912	3	76,000	25,333
1913	3	132,000	44,000
1914	3	180,000	60,000
1915	4	199,000	49,750
1916	4	224,000	56,000
1917	4	248,000	62,000
1918	6	262,000	43,667
1919	6	303,000	50,500
1920	10	488,000	48,800
1921	11	617,500	56,136
1922	13	816,214	62,786
1923	13	952,882	73,299
1924	14	994,145	71,010
1925	18	1,344,385	74,688
1926	19	1,606,065	84,530
1927	20	1,499,366	74,968
1928	28	1,896,503	67,732
1929	31	2,115,621	68,246
1930	39	2,481,718	63,634
1931	43	3,599,750	83,715
1932	50	4,245,382	84,908
1933	56	5,487,691	97,994
1934	60	6,615,559	110,259
1935	64	7,965,539	124,462
1936	64	8,608,558	134,509

*Data were obtained from 64 country fruit and vegetable auctions which operated during 1936, and from 9 which ceased operating before 1936. 1911 was the first year in which auctions of this type began operating in the Eastern Seaboard States.

AUTHOR'S ACKNOWLEGMENTS. This study was conducted under the general direction of Dr. M. P. Rasmussen, Professor of Marketing, New York State College of Agriculture at Cornell University, through a cooperative arrangement between the New York State College of Agriculture and the Farm Credit Administration. The author wishes to express appreciation to Dr. Rasmussen as well as to the auction managers, owners, and other officials, and to auction buyers, grower-patrons, and others, whose cooperation made this study possible.

[1] Also presented to the faculty of the Graduate School of Cornell University, June, 1939, as a thesis in partial fulfillment of the requirements for the degree of doctor of philosophy.

Farm Credit Administration, undertook a study of the status of country fruit and vegetable auctions.

PURPOSE OF STUDY

The purpose of this study was to obtain such facts as might be available concerning country fruit and vegetable auctions which might assist growers, cooperative associations, and others in appraising the importance and effectiveness of such auctions in marketing fruits and vegetables. It was hoped that such a study might throw some light on the factors which are most important in determining success or failure of country fruit and vegetable auctions.

SCOPE OF STUDY

Data were obtained from 64 country fruit and vegetable auctions which operated during 1936 in 10 Eastern Seaboard States, and from 9 which ceased to operate before 1936. These auctions were found in 10 States ranging from Massachusetts on the north, to Florida on the south (figures 1 and 2). Fifty-four, or almost 85 per cent, of these auctions were found in five States, Virginia, North Carolina, Maryland, New Jersey, and Delaware (table 29, appendix). Information concerning use made of these auctions was also obtained from 431 growers of fruits and vegetables as well as from 114 buyers, who purchased produce on one or more of these auctions.

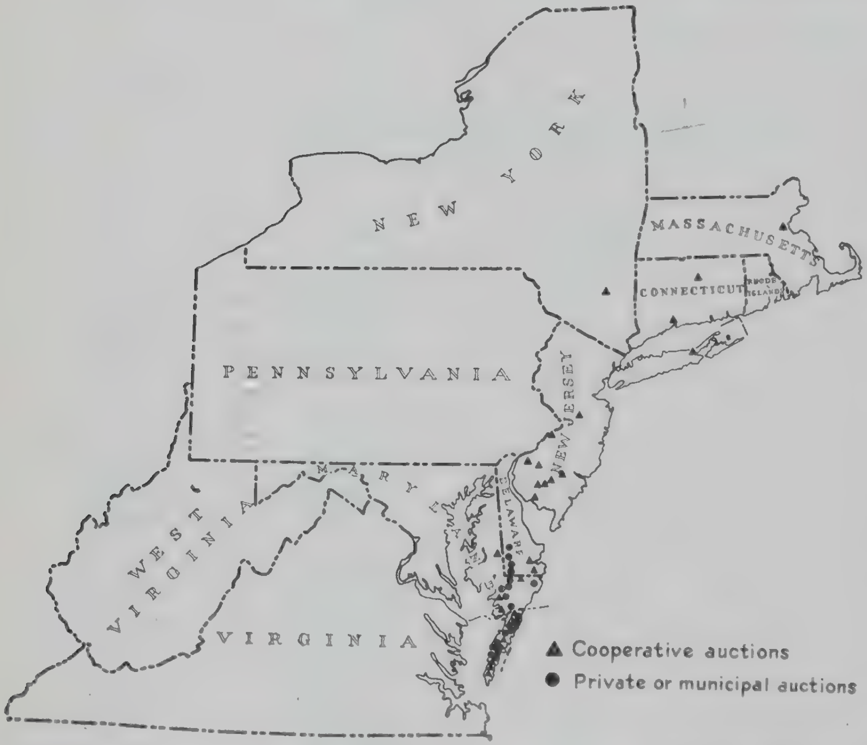

FIGURE 1. LOCATION OF 48 COUNTRY FRUIT AND VEGETABLE AUCTIONS WHICH OPERATED DURING 1936

This study covered auctions which handled fruits and vegetables that arrived via motor truck, wagon, or automobile at country shipping points or farmers' markets; employed an auctioneer; and had physical facilities for conducting an auction business.

FACILITIES USED FOR AUCTION PURPOSES

Facilities used by these 64 auctions varied from simple, single-drive open-end sheds (figure 3), to double-driveway sheds (figure 4), and relatively large and elaborate buildings (figure 5). In the shed-type facilities (figures 3 and 4), the shed usually provided seats for buyers and protected them from rain and sun. Platforms or benches, on either side of the driveway, enabled buyers to inspect produce as it moved through the open driveway and was offered for sale by the auctioneer. Procedure at the most elaborate auction (figure 5) may have been influenced by near-by tobacco auctions. When the auction was operating, driveways were occupied by motor trucks and wagons loaded with produce, and sample packages from each load were placed on the center platform. The auctioneer, accompanied by buyers, walked up and down the platform, and produce was sold on the basis of the samples displayed.

AUCTIONS IN 4 NORTHERN STATES IN 1936[2]

The quantity of produce sold through country fruit and vegetable auctions in the 4 northern States increased from about 55,000 packages in 1912, to more than 4 million packages in 1936 (table 30, appendix). Development of auctions has been much more rapid in some States than in others.

Massachusetts. An auction was established in the fall of 1935 at the Boston Regional Produce Market, West Cambridge. This auction handled a wide variety of fruits and vegetables, but in 1936, apples were most important in volume of sales.

Connecticut. One auction organized in 1932 operated at the farmers' market in New Haven, Connecticut, during 1936. Another was organized at Manchester in 1933. The volume of business at these auctions has increased substantially each year since they were organized. The New Haven auction handled mainly strawberries. At the Manchester auction, a wide variety of fruits and vegetables were available, of which cauliflower, strawberries, and peaches were most important.

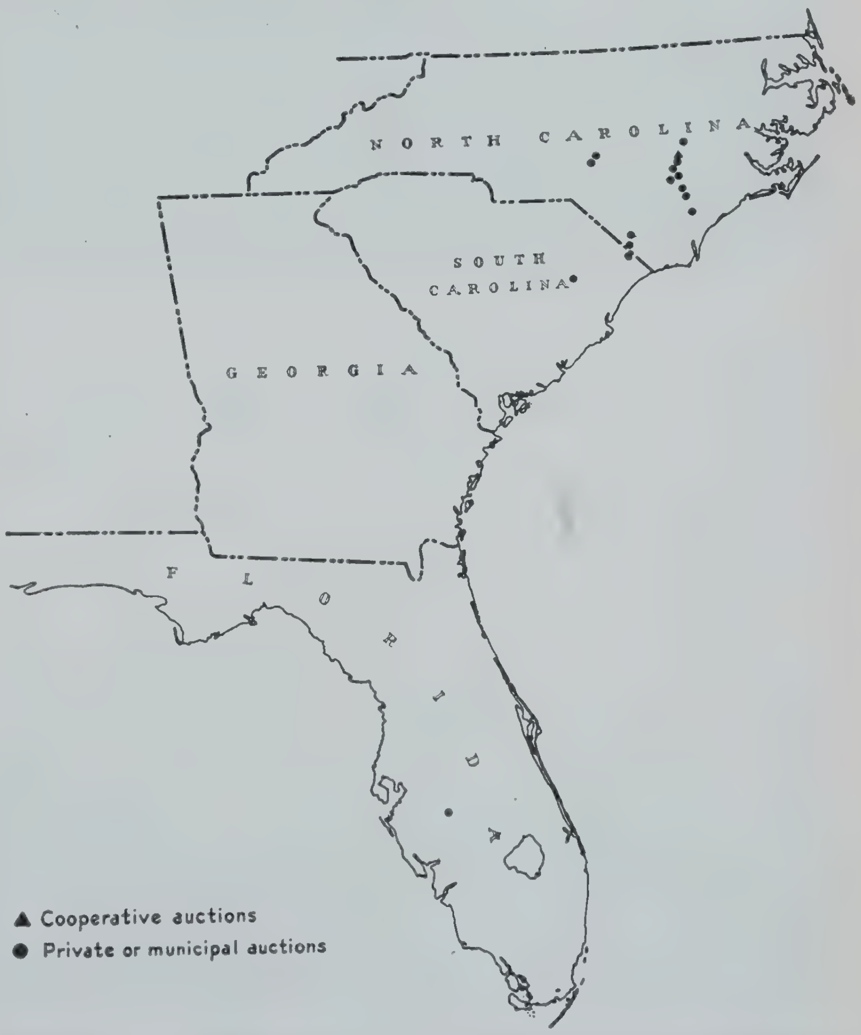

FIGURE 2. LOCATION OF 16 COUNTRY FRUIT AND VEGETABLE AUCTIONS WHICH OPERATED DURING 1936

New York. Two of the 64 auctions which operated in 1936, were located in New York State. The Riverhead Cauliflower Growers' Association, at Riverhead, Long Island, is the second oldest auction of this type in the East. It was established in 1912, one year after an auction began operations at Marion Station, Maryland.

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[2] The term *northern States* as used in this report means the States of Massachusetts, Connecticut, New York, and New Jersey.

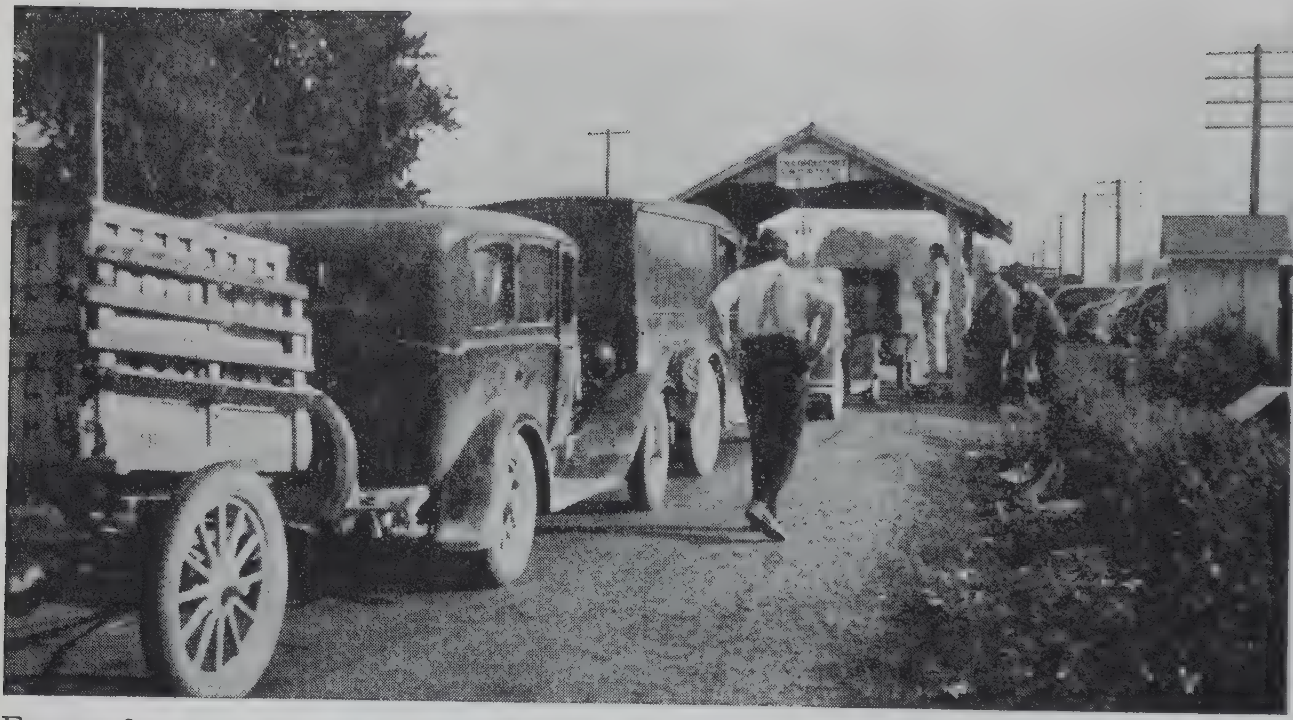

FIGURE 3. SIMPLE SHED FACILITY, ERECTED ACROSS HIGHWAY, BRIDGEVILLE, DELAWARE

Nearly 800 growers patronized the Riverhead auction during 1936, and only one other auction of this type did a larger business, whether measured in number of packages of fruits and vegetables sold or in gross dollar sales.

The Mid-Hudson Fruit Auction was operated by the Cooperative Grange League Federation, Inc., at Highland, New York, in the Hudson River fruit belt, and handled mostly fruit.

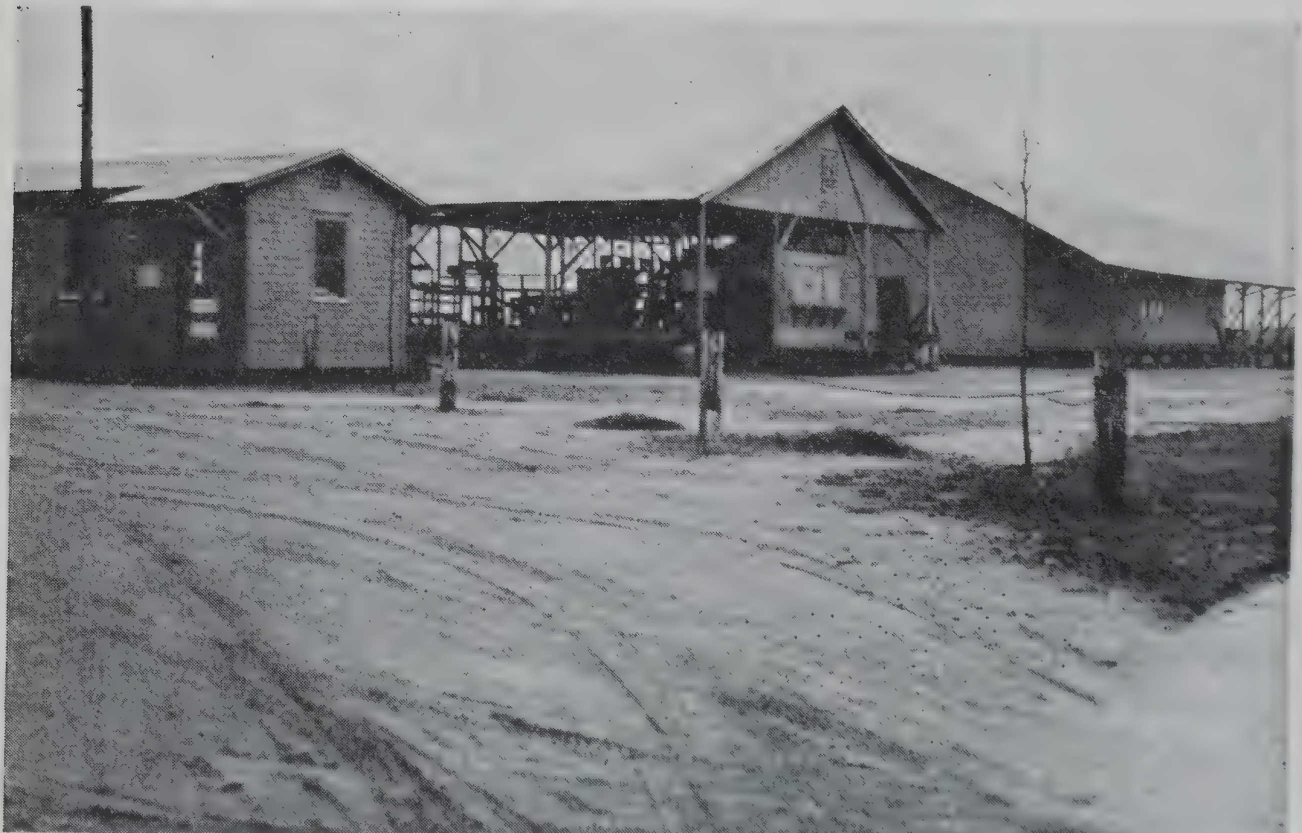

FIGURE 4. DOUBLE-DRIVEWAY AUCTION FACILITY, WITH OFFICE BUILDING AND LOADING PLATFORMS, GLASSBORO, NEW JERSEY

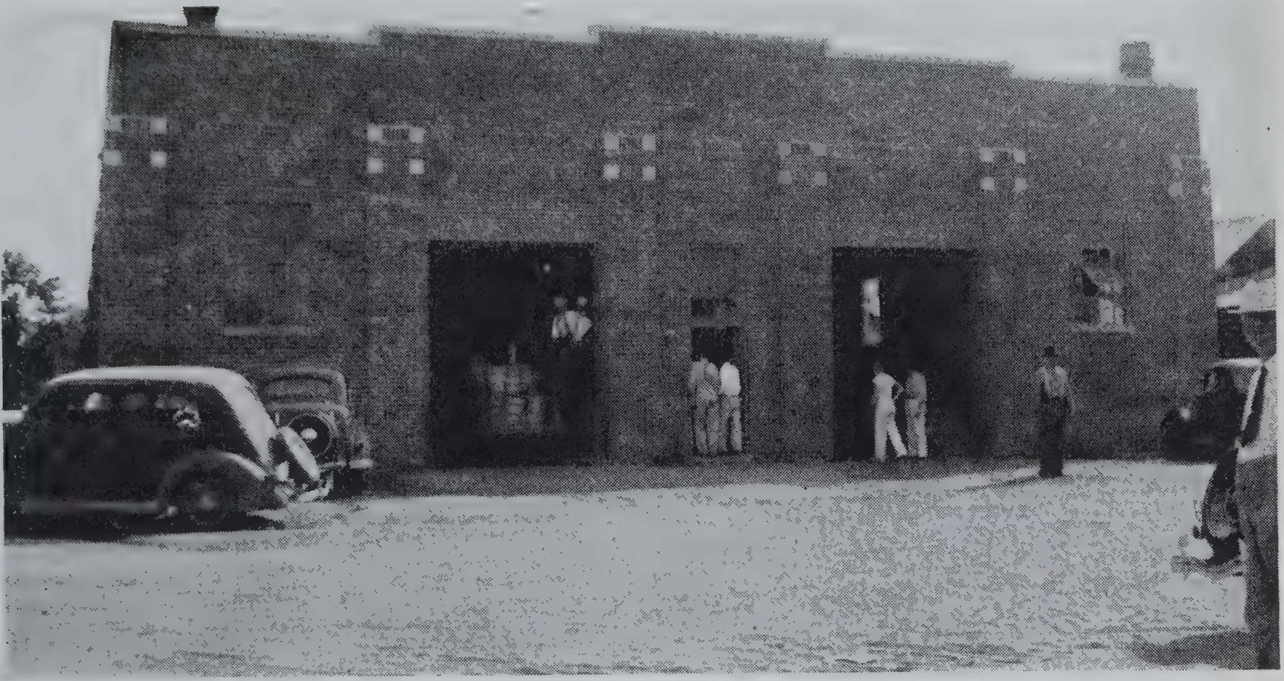

Figure 5. LARGE BRICK AUCTION FACILITY, OF DOUBLE-DRIVEWAY TYPE, LAKE CITY, SOUTH CAROLINA

Subsequently to this study, country fruit and vegetable auctions have also been established at Livingston (handling fruit) ; at Margaretville (handling cauliflower) ; at Hicksville, Long Island (handling mostly potatoes and vegetables) ; and at Williamson, in the western New York fruit and vegetable belt.

New Jersey. Auctions were first formed at Cedarville and Rosenhayn, in the intensive berry and vegetable area in the southern part of the State, in 1928. The volume sold at auction grew from about 160,000 packages handled by these two auctions in 1928, to more than 3 million packages handled by 9 auctions in 1936. Fourteen auctions in all have been established in New Jersey, 9 of which operated during 1936.[3] A wide variety of products were handled, such as tomatoes, peppers, cucumbers, snap beans, sweet potatoes, Irish potatoes, onions, cantaloupes, apples, strawberries, etc.

AUCTIONS IN 6 SOUTHERN STATES IN 1936[4]

With the sole exception of the auction at Riverhead, New York, country fruit and vegetable auctions were used much earlier in the South than in the North. Prior to 1928, 19 auctions were in operation in the five southern States from Delaware to South Carolina, and 35 additional auctions had been established in the southern States by 1936. Of all these auctions, 50 operated during 1936.

The volume of sales at these southern auctions increased from about 10,000 packages in 1911 to nearly 4,500,000 packages in 1936.

Delaware. The first country fruit and vegetable auction was established in Delaware about 1920, at Seaford. Six auctions were operating in Delaware in 1936 (table 29, appendix), and strawberries, cantaloupes, cucumbers, and tomatoes were the most important commodities handled.

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[3] Auctions operated during 1936 at Hightstown, Beverly, Swedesboro, Glassboro, Hammonton, Landisville, Vineland, Rosenhayn, and Cedarville.

[4] The term *southern States* as used in this report means the States of Delaware, Maryland, Virginia, North Carolina, South Carolina, and Florida.

Maryland. Auctions in Maryland seem to have limited their activities to that section of the State known as the *Eastern Shore.* The first of all of these auctions was reported as having been established at Marion Station, about 1911, but an additional eleven were subsequently established at other points, and ten of these operated during 1936 (table 29, appendix).

From about 10,000 packages handled by one auction in Maryland during 1911, sales increased to nearly 900,000 packages handled by 10 auctions in 1936. Strawberries, cantaloupes, cucumbers, string beans, and lima beans were the most important commodities handled by Maryland auctions.

Virginia. In 1936, auctions in Virginia were located entirely in Accomac and Northampton Counties on the Eastern Shore. The first auction in Virginia is reported to have been established at Onley about 1912, and there were 18 auctions in operation during 1936 (table 29, appendix).

Volume of sales increased from about 8000 packages during 1912 to nearly 500,000 packages in 1936. Strawberries, string beans, broccoli, and lima beans were the most important commodities handled by Virginia auctions.

North Carolina. Country fruit and vegetable auctions in North Carolina are located in the southeastern part of the State. The first bona-fide auction in the State was established at Tabor City in 1915. By 1936, there were 13 of these auctions in operation in North Carolina (table 29, appendix). Sales had increased from about 8000 packages sold through one auction in 1915 to 1,300,000 packages in 1936. Strawberries, string beans, peas, green peppers, potatoes, sweet corn, cucumbers, and dewberries were the most important commodities handled by North Carolina auctions.

South Carolina. Only two country fruit and vegetable auctions had been established in South Carolina by 1936, one at Loris and another at Lake City. Another auction began operating at Ehrhardt, South Carolina, in 1937.

Florida. A small auction was established in 1934, at Wauchula, Florida. Its volume of business rose rapidly from 1934 to 1936. Cucumbers, strawberries, green peppers, eggplant, string beans, and lima beans were the most important commodities handled. The success of this auction led to the establishment at Wauchula, in 1937, of a large state market which uses the auction method of sale exclusively.

FACTORS INFLUENCING DEVELOPMENT

It seems to be generally agreed that increased possibilities of hauling produce from farm to market by motor truck has been a most important factor influencing the growth of country fruit and vegetable auctions. Although some of the auctions are patronized by buyers who ship by rail, a large share of the patronage comes from buyers of one type or another who transport their purchases in their own or hired motor trucks. The registrations of motor trucks in the United States rose from about 2.4 millions in 1925, to almost 4 millions in 1935, an increase of about 66 per cent during the 11-years period.[5] During the same period, the number of country auctions increased from 18 to 64, or 255 per cent.

It seems likely that the presence of relatively large surpluses at many shipping points may have stimulated efforts to find more rapid and efficient methods of distribution. According to the United States Department of

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[5] Automobile facts and figures, p. 4. Automobile Manufacturers' Assoc. 21st edition, 1939.

Agriculture, the acreage of commercial truck crops for shipment fresh in the North Atlantic and South Atlantic States rose from about 256,000 in 1919, to about 681,000 acres in 1938 (an increase of about 166 per cent).[6]

In 1920, costs of distributing food and prices paid to farmers for food in the United States were in fairly close adjustment; the index number (using the period 1910–1914 = 100) of prices paid to farmers for food material stood at 212, while the corresponding index of costs of distributing food was 203.[7] By 1932 the index of farm prices had fallen to 65 (a decline of about 69 per cent), whereas the cost-of-distribution index had declined only 24 per cent to 153. In 1936, the index of farm prices stood at 117, compared with a cost-of-distribution index of 171. It is probable that the establishment of many country fruit and vegetable auctions from 1928 to 1936 represented desperate efforts on the part of growers to find some way to alleviate the serious maladjustments caused by the sharp decline in the price level of farm products.

Other factors which have probably influenced the establishment of country auctions were dissatisfaction on the part of growers with returns from sales through other outlets, rivalry between villages or towns which may have resulted in the establishment of duplicate auction facilities, and the strong desire on the part of growers to sell for cash. The low operating costs of these auctions was likewise probably an important factor.

OPERATING METHODS AT COUNTRY AUCTIONS

PERSONNEL

Because no two auctions seem to have operated in precisely the same manner, it is difficult to describe them accurately without resorting to infinite detail. The following general observations may be of interest. The number of employees at these auctions varied from one at small auctions, to eighteen or twenty at the larger cooperative auctions, and averaged about four per auction. Some of the larger auctions employed a manager, an auctioneer, a clerk, four or five package boys, an errand boy, two or more other platform men (who open and dump sample packages for inspection by buyers), one or more yardmen, and four or five clerks in the office. Eleven auctions also paid a part of the expense of inspection.

SEASON OF OPERATION

Most of the auctions were closed during the winter and early spring months, and operated only in the late spring or summer. Operations were usually discontinued when income from the daily business was regarded as insufficient to justify expenses. Three auctions, however, operated during the entire year and handled non-perishable commodities during the winter months.

PAYMENT TO GROWERS

At most of the private auctions, growers were paid directly by the buyers. The time and frequency of payment varied from immediately after the sale to a yearly settlement at the end of the season. In most cases, growers collected from the buyers on one or two days a week generally called *pay days.* At private auctions, most outside buyers were required to buy through a local dealer. Growers collected for all auction sales at the offices of the local dealers. Most of the cooperative auctions collected from the buyers, assumed all credit risks, and paid the growers once or twice a week.

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[6] Outlook charts, 1940, potatoes and truck crops, p. 14. U. S. Agr. Dept., Bur. Agr. Econ.
[7] Farm econ., no. 116, p. 2849, January, 1940. New York State Coll. Agr.

CHARGES MADE FOR AUCTION SERVICES

The charges made to growers for services performed by auctions varied considerably. Most of the private auctions charged a stipulated rate per package. Most of the cooperative auctions varied the rate according to the price received or charged a stipulated percentage of the gross sales per package. In a few cases, buyers as well as growers were required to pay a fee to cover certain services performed by the auctions.

RECORDING CONTENTS OF LOADS

All auctions found it necessary to obtain a record of the contents of each truckload, wagonload, or autoload offered for sale. At private auctions, the grower usually called out the number of packages of each commodity in his load on entering the auction shed, and the auction clerk recorded it opposite the grower's name. At a few cooperative auctions, employers interviewed each grower in line before entering the shed, and listed the number of packages of each commodity the grower had for sale.

Most of the cooperative auctions used a "load slip", on which the grower inserted his name and the number of packages of each commodity before arrival at the auction block. The load slip was then handed to the clerk, who copied the information on a permanent record, and at the same time held the slip so the auctioneer could use it as a guide in selling the load. When the sale was concluded, the clerk recorded the price realized per package and the buyer who bought each lot.

SELLING

The sales were usually made from samples shown. Samples of such commodities as string beans and sweet potatoes were dumped in sample bins for inspection. Such commodities as strawberries or cantaloupes were examined by buyers either through the top or side of the package.

If the displayed sample did not fairly represent the lot, the buyer usually was accorded the privilege of rejecting the lot when the grower made delivery. Buyers usually had a man at the truck, shed, or car to check the lots purchased. On all cooperative auctions, the manager or an inspector was ordinarily present to arbitrate disputes between growers and buyers. On private auctions, the disputing parties usually came to terms unassisted. At most auctions, the sale was not considered complete until the buyer or his representative indicated acceptance by signing a receipt for the produce.

At private auctions, sales slips were made out by local buyers, who had the privilege of buying on the block, or by some outside buyer using the sales-slip book of a local buyer, and paying him a brokerage fee. Only one duplicate was made. The grower was given the original and the buyer kept the duplicate. At cooperative auctions, two or three copies were made. If three, the grower received one, the buyer one, and the auction kept the original.

Each lot was sold to the highest bidder, except in the comparatively small number of cases when growers availed themselves of the "no sale" privilege, or refused to sell at the highest price bid. It was a grower's privilege

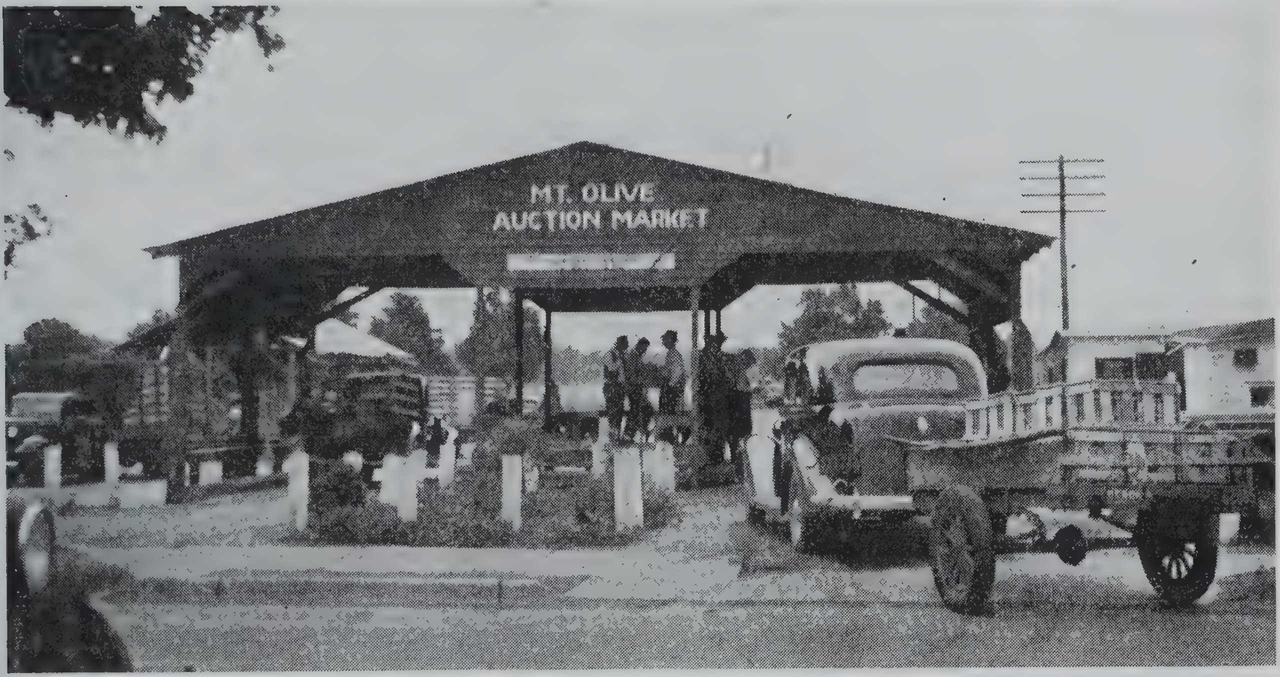

FIGURE 6. AN AUCTION AT MOUNT OLIVE, NORTH CAROLINA, OPERATED BY AN INFORMALLY ORGANIZED GROUP OF GROWERS, AND ESSENTIALLY COOPERATIVE IN CHARACTER

to "no sale" a lot at any time before it left the auction shed. No auction fee was charged for packages not sold.

OWNERSHIP AND CONTROL

Twenty-seven of the 64 country fruit and vegetable auctions were either owned or operated, or both, by some type of farmers' cooperative association, or informal farmers' group. The auction at Mount Olive, North Carolina, is a typical example of auctions owned and operated by unincorporated farmers' groups (figure 6); while the auction at Highland, New York (figure 7) is an example of ownership and operation by an incorpo-

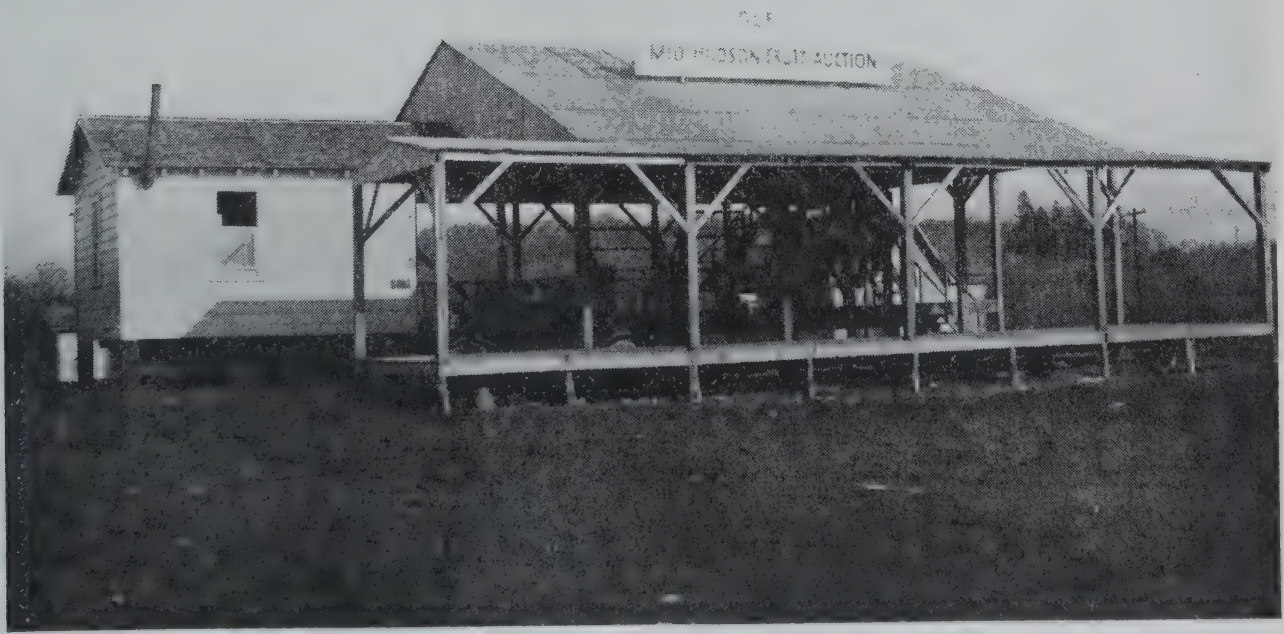

FIGURE 7. THE MID-HUDSON FRUIT AUCTION, AT HIGHLAND, NEW YORK, WAS OPERATED BY A COOPERATIVE EXCHANGE

rated farmers' cooperative association. Of the remaining 37 auctions, 28 were privately owned and operated by buyers; 5 were owned by municipalities; 2 were owned by local banks; one by a local insurance man; and one by an auctioneer.

COMMODITIES HANDLED

During 1936, 48 vegetables and 18 fruits, in addition to eggs, walnuts, Christmas trees, and holly wreaths, were sold at these 64 country auctions (table 2). Only ten of the 64 auctions handled as many as 15 vegetables, and only as many as 4 vegetables and one fruit were handled by 20 of the auctions.

Over two-thirds of the auctions handled strawberries and more than half handled string beans. Cucumbers, lima beans, and green peas were each handled by about a third of the auctions; and peppers, cantaloupes, squash, tomatoes, Irish potatoes, broccoli, eggplant, cabbage, huckleberries, apples, onions, carrots, pickle cucumbers, and sweet corn by 10 or more of the auctions.

TABLE 2. COMMODITIES HANDLED BY 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS IN 10 EASTERN SEABOARD STATES, 1936*

Commodity	Number of auctions	Per cent of total†
Vegetables:		
String beans	34	53
Cucumbers	28	44
Lima beans	22	34
Peas, green	20	31
Peppers	17	27
Squash	16	25
Tomatoes	15	23
Irish potatoes	12	19
Broccoli	12	19
Eggplant	12	19
Cabbage	11	17
Onions	10	16
Carrots	10	16
Pickle cucumbers	10	16
Sweet corn	10	16
Sweet potatoes	9	14
Spinach	9	14
Dandelion greens	9	14
Scallions	9	14
Beets	9	14
Asparagus	8	12
Fava beans	8	12
Parsley	8	12
Lettuce	7	11
Radishes	7	11
Turnips	7	11
Celery	7	11
Parsnips	7	11
Rhubarb	7	11
Pumpkins	6	9
Okra	6	9
Kale	5	8
Leeks	5	8
Beet greens	5	8
Romaine	4	6
Brussels sprouts	4	6
Cauliflower	4	6
Chinese cabbage	4	6
Mushrooms	4	6
Swiss chard	4	6
Vegetables:		
Sour grass	3	5
Rape	3	5
Shell beans	2	3
Kentucky wonder beans	2	3
Dill	2	3
Kohlrabi	2	3
Chicory	2	3
Poke	1	2
Fruits:		
Strawberries	44	69
Cantaloupes	16	25
Huckleberries	11	17
Apples	10	16
Watermelons	9	14
Blackberries	8	12
Dewberries	8	12
Peaches	7	11
Pears	7	11
Raspberries	7	11
Cherries	7	11
Grapes	7	11
Gooseberries	6	9
Currants	5	8
Plums	4	6
Crabapples	3	5
Quinces	2	3
Cranberries	1	2
Other commodities:		
Eggs	3	5
Walnuts, black	1	2
Christmas trees	1	2
Holly wreaths	1	2

*Massachusetts, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina South Carolina, and Florida.

†Percentages do not add to 100 because many auctions handled more than one commodity.

The 64 auctions handled an average of 8 commodities per auction during 1936. The 14 auctions in the northern States handled an average of 23 commodities per auction, and 50 auctions in the southern States handled an average of 3 commodities per auction during 1936.

TOTAL VOLUME HANDLED

Approximately 8.6 million packages of fruits and vegetables, with a total value of more than 9 million dollars were sold during 1936 at these 64 auctions (table 3). In gross value, strawberries were outstandingly the most important single commodity. Approximately one million crates of strawberries were sold at auction for more than 3.3 million dollars, or more than a third of the total gross value of all commodities sold at auction. In number of packages sold at auction, however, tomatoes ranked slightly above strawberries; and string beans, cantaloupes, cauliflower, cucumbers, and green peppers were almost as important as strawberries.

COMPARISON OF SALES AT AUCTION WITH TOTAL PRODUCTION

The importance of country fruit and vegetable auctions in the distribution of fruits and vegetables may be measured in some degree by the proportion of the total production of all fruits and vegetables which was sold at such auctions in the areas served by these auctions.

TABLE 3. VOLUME OF SALES OF IMPORTANT COMMODITIES,* AS REPORTED BY 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Commodity	Type of package or unit of sale	Packages sold		Gross value	
		Total	Percentage of total	Total	Percentage of total
		Number	*Per cent*	*Dollars*	*Per cent*
Tomatoes	⅝-bushel basket	1,129,190	13.1	426,292	4.7
Strawberries	32-quart crate	1,117,078	13.0	3,305,845	36.5
String beans	Bushel hamper	1,028,507	11.9	945,985	10.4
Cucumbers	Bushel basket	853,361	9.9	620,844	6.9
Cantaloupes	Crate of 24	753,428	8.7	610,902	6.7
Cauliflower	Crate of 12	697,629	8.1	563,044	6.2
Green peppers	Bushel basket or hamper	644,156	8.1	332,782	3.7
Lima beans	Bushel hamper	287,254	3.3	400,643	4.4
Sweet potatoes	Bushel basket or hamper	212,549	2.5	168,482	1.9
Green corn	Bushel crate and 75-ear bag	198,262	2.3	131,366	1.5
Apples	Bushel basket or crate	179,871	2.1	115,746	1.3
Peaches	Bushel and ½-bushel basket	157,817	1.6	134,692	1.5
Onions	50-pound bag	141,832	1.6	110,474	1.2
Watermelons	Each	136,495	1.6	16,594	0.2
Green peas	Bushel hamper	133,479	1.5	147,426	1.6
White potatoes	100-pound sack or 11-peck barrel	123,657	1.4	271,367	3.0
Eggplant	Bushel hamper or basket	75,761	0.9	91,425	1.0
Dewberries	24 and 32-quart crate	55,847	0.6	106,858	1.2
Raspberries	36 and 60-pint crate	31,963	0.4	113,151	1.3
Blackberries	32-quart crate	31,013	0.4	103,829	1.1
Miscellaneous commodities†	Bushel	619,409	7.0	341,276	3.7
Total		8,608,558	100.0	9,059,023	100.0

*Commodities which make up one per cent or more of either the total number of packages, or the total gross value.

†Includes all other commodities not included in the leading 20 (for list of all commodities see table 2, page 16).

The most usable estimate obtainable for the total production of fruits and vegetables in the area served by these auctions is data concerning production of 23 truck crops for market, 9 truck crops for manufacture, and 12 fruit crops.[8] It seems likely that sales at country fruit and vegetable auctions accounted for approximately 2.3 per cent of the total production of all fruits and vegetables in the 10 Eastern Seaboard States.

About 4.6 per cent of the total production of all fruits and vegetables in the five States from New Jersey to North Carolina was sold at country auctions, while less than one per cent was sold by this method in the other five States. Tomatoes, Irish potatoes, sweet potatoes, and citrus and other fruits made up a large proportion of the total fruits and vegetables produced in the 10 Eastern Seaboard States. Only small quantities of these products were sold at country auctions.

For certain crops, however, a relatively large share of the total production was sold at auctions in these States. For the 10 States as a whole, 47 per cent of the strawberries, 43 per cent of the lima beans, 40 per cent of the cauliflower, 38 per cent of the cantaloupes and cucumbers, and about 20 per cent of the green peppers were sold at auction. Approximately 10 per cent of the string beans, green corn, eggplant, and green peas produced in the 10 States was likewise sold at auction. On the other hand, sales at country auctions accounted for only about 4 per cent of the tomatoes, about 2 per cent of the onions, and about one per cent each of the Irish potatoes, sweet potatoes, watermelons, peaches, and apples produced in the 10 States.

RANGE IN VOLUME OF FRUITS AND VEGETABLES HANDLED

The number of packages of fruits and vegetables sold by individual auctions ranged from less than 1000 handled by a strawberry auction in Virginia, to slightly more than 800,000 packages of miscellaneous fruits and vegetables handled by an auction in New Jersey.

Approximately one-fourth of these auctions sold less than 25,000 packages of fruits and vegetables, and 37 of 64 handled less than 100,000 each during 1936 (table 4). On the other hand, 7 auctions handled more than 400,000 packages during the year. The average number of packages handled per auction was about 135,000.

TABLE 4. AVERAGE NUMBER OF PACKAGES OF FRUITS AND VEGETABLES HANDLED, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in number of packages handled*	Auctions	Percentage of total auctions	Average packages per auction
Thousands	*Number*	*Per cent*	*Number*
Less than 25	15	24	11,272
25– 49	11	17	35,986
50– 99	11	17	75,560
100–199	16	25	135,270
200–399	4	6	312,161
400 or more	7	11	542,786
Total or average	64	100	134,509

*The range in volume of business was from 950 to 803,227 packages per auction.

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[8] These data comprise all fruit and vegetable crops for which the Crop Reporting Board, of the United States Department of Agriculture, Bureau of Agricultural Economics, made estimates of production for any of the 10 Eastern Seaboard States in which country fruit and vegetable auctions operated during 1936.

Fruit and vegetable sales per auction varied from less than $2500 to slightly more than $600,000, and the average volume of fruit and vegetable sales for the 64 auctions was about $142,000 per auction (table 5). About 52 per cent reported sales aggregating less than $100,000 for the year, but 5 auctions (or 8 per cent) had average sales of more than half a million dollars.

TABLE 5. AVERAGE GROSS SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in volume of sales*	Auctions	Percentage of total sales	Average volume of sales per auction
Dollars	*Number*	*Per cent*	*Dollars*
Less than 25,000	8	13	9,230
25,000– 49,999	9	14	34,977
50,000– 99,999	16	25	61,622
100,000–199,999	15	23	145,031
200,000–399,999	11	17	268,673
400,000 or more	5	8	510,583
Total or average	64	100	141,547

*The range in volume of sales was from $2470 to $600,120 per auction.

FACTORS INFLUENCING VOLUME OF SALES PER AUCTION

Adequate information was not available to determine *all* of the factors which may have influenced the volume of fruit and vegetable sales per auction. The ability of auctioneers and managers to attract and hold growers and buyers, and the "quality" of the service offered, as well as other intangible factors, cannot be measured statistically. It seems likely that the volume of fruit and vegetable sales per auction depended on various combinations of factors rather than any single one, and that those auctions with the greatest number of favorable factors tended to have the largest volume of sales.

Despite these reservations, such data as are available have been briefly analyzed in the hope that it may be of some assistance to growers and cooperative associations who are interested in existing or prospective country fruit and vegetable auctions.

NUMBER OF COMMODITIES HANDLED

Twenty of these auctions (or about one-third) handled only one commodity, and averaged less than $60,000 worth of fruit and vegetable sales during 1936; while 17 auctions, which handled, on the average, about 22 commodities each, attained fruit and vegetable sales averaging nearly $220,000 each (table 6). For all of the 64 auctions, fruit and vegetable

TABLE 6. RELATION OF NUMBER OF COMMODITIES HANDLED TO SALES PER AUCTION, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in number of commodities handled	Average commodities handled	Auctions in group	Average gross sales per auction
	Number	*Number*	*Dollars*
1	1	20	59,017
2–3	2.3	13	132,543
4–7	5.1	14	175,214
8 or more	21.5	17	217,801

sales averaged nearly $142,000 and 8 commodities were handled per auction.

There appears to have been some relationship between the number of commodities handled and the total dollar volume of sales; that is, the greater the number of commodities handled, the larger the volume of sales. (This may suggest to some auction managers one possible method of increasing sales volume and reducing costs of operation per package.)

KIND OF COMMODITIES

The kind of commodity also seems to have had some influence on fruit and vegetable sales per auction, although the exact effect is not so obvious because of the widely varying conditions under which these auctions operated. Such data as are available, however, indicate that auctions which handled strawberries alone had larger sales than did single-commodity auctions handling either broccoli or dewberries; and that for two out of three groups, auctions handling strawberries in combination with one or more other commodities had larger average sales than did auctions handling combinations of commodities that did not include strawberries (table 7). Strawberries and relatively perishable fruits and vegetables seem to be particularly well adapted for sale at country fruit and vegetable auctions.

LENGTH OF OPERATING SEASON

There was a wide disparity in length of season during which these 64 auctions operated. Some operated only 11 days, and others throughout the year. Twenty-seven (or about 42 per cent) were open less than 50

TABLE 7. NUMBER AND KIND OF COMMODITIES HANDLED AND VOLUME OF SALES PER AUCTION, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Number and kind of commodities handled	Auctions	Fruit and vegetable sales per auction
	Number	*Dollars*
One commodity:		
Strawberries	16	66,400
Broccoli	2	10,750
Dewberries	2	48,220
Total or average	20	59,017
Two or three commodities:		
Strawberries and one or two others	7	157,882
Cantaloupes and cucumbers	3	154,614
String beans and lima beans	2	51,425
Green peppers and squash	1	51,200
Total or average	13	132,543
Four to seven commodities:		
Strawberries and several vegetables	9	169,508
Several vegetables	5	185,486
Total or average	14	175,214
Eight or more commodities:		
Strawberries and several vegetables	12	245,463
Several fruits and vegetables	5	151,411
Total or average	17	217,801
All auctions	64	141,547

days during 1936, and 7 (or about 10 per cent) operated 150 days or more (table 8).

It will be noted that the auctions which operated for only relatively short periods had relatively small sales (about $75,000 per auction), and that the largest volume of sales (about $257,000) was obtained by the auctions which operated for an average period of about 229 days.

In areas where a sufficient number of commodities are available in relatively large volume in season, it seems likely that extending the period of operation may result in substantially larger volumes of sales.

TABLE 8. RELATION OF LENGTH OF OPERATING SEASON TO SALES OF FRUITS AND VEGETABLES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in length of operating season	Average length of operating season	Auctions in each group	Average gross sales of fruits and vegetables per auction
Days	*Days*	*Number*	*Dollars*
Less than 50	27	27	75,526
50– 99	69	16	169,993
100–149	119	14	176,476
150 or more	229	7	257,467

DISTANCE TO NEAREST COMPETING AUCTION

In some areas, auction facilities may have been developed too hastily and in too close proximity to one another for maximum efficiency. For all 64 auctions, the range in distance to the nearest competing auction was from less than one mile to approximately 150 miles. Two of these auctions were located at one small shipping point on the Eastern Shore of Virginia, and were only about one-tenth of a mile apart; whereas the auction at Riverhead, New York, was approximately 150 miles from its nearest competing auction in 1936.

The average distance to the nearest competing auction for all auctions which operated in 10 Eastern Seaboard States during 1936 was about 16 miles. At that time, 28 per cent were less than 5 miles from the nearest competing auction, 28 per cent from 5 to 9 miles, 27 per cent from 10 to 14 miles, and 17 per cent were located 15 miles or more from their nearest competitor (table 9).

The auctions which were less than 5 miles from the nearest competing auction, reported fruit and vegetable sales averaging about $100,000; those

TABLE 9. RELATION OF DISTANCE TO NEAREST COMPETING AUCTION TO SALES OF FRUITS AND VEGETABLES PER AUCTION, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in distance to nearest competing auction	Average distance to nearest competing auction	Auctions in group	Average sales of fruits and vegetables per auction
Miles	*Miles*	*Number*	*Dollars*
Less than 5	3	18	100,237
5– 9	7	18	119,406
10–14	11	17	164,594
15 or more	61	11	209,760

from 5 to 9 miles from competing auctions had average sales of nearly $120,000; while the 11 auctions located 15 miles or more from their nearest competitors averaged about $210,000. The closer the auctions were to one another, the more difficult it seems to have been to obtain an adequate volume of business. It should be noted that 53 of the 64 auctions had another auction not over 14 miles distant. It seems likely that some of the near-by auctions, within 5 or 10 miles of one another, might find it advantageous to consolidate their operations. New auctions should probably not be established within 10 or 15 miles of other auctions.

AREAS SERVED

The diameter of the average area served by these 64 auctions was estimated at about 21 miles. Eight auctions served areas less than 10 miles in diameter, 21 auctions from 10 to 19 miles, 22 auctions from 20 to 29 miles, and 13 auctions served areas with estimated diameters of 30 miles or more. The range in the diameters of the areas served was from 4 to 60 miles. Two of the auctions on the Eastern Shore of Virginia drew growers from not more than 2 miles in each direction, while the auction at Wauchula, Florida, was patronized by growers from six counties extending 30 miles in each direction.

The 8 auctions which served areas with estimated diameters of less than 10 miles had average fruit and vegetable sales of less than $15,000, while the 13 auctions which served areas 30 miles or more in diameter averaged nearly $390,000 in fruit and vegetable sales during 1936 (table 10). Careful consideration of the size of the producing area which is available to be served by an auction, as well as the intensity of production of fruits and vegetables adaptable to auction sale, would seem to be basic requisites to the establishment and maintenance of successful auctions.

TABLE 10. RELATION OF APPROXIMATE AREA SERVED TO SALES OF FRUITS AND VEGETABLES PER AUCTION, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in diameter of area served	Average diameter of area served	Auctions in each group	Sales of fruits and vegetables per auction
Miles	*Miles*	*Number*	*Dollars*
Less than 10	6	8	14,518
10–19	15	21	69,205
20–29	23	22	170,137
30 or more	36	13	288,197

SOURCES OF INCOME FOR AUCTIONS

FEES PAID BY GROWERS

Fees paid by growers were the most important source of income, amounting to approximately $165,000 (or about two-thirds of the total) for all auctions during the calendar year 1936. Brokerage fees paid by outside buyers to local brokers accounted for about 25 per cent (table 31, appendix).

There were many different systems or schedules of fees charged growers in 1936. Of the 14 northern auctions, 7 used systems of variable fees based on value per package or size of package. The other 7 northern auctions charged either a percentage of gross sales, or a definite fee per package, regardless of size or value.

Sixteen of the southern auctions which handled strawberries only, charged growers a standard fee of about two cents per crate. At the remaining southern auctions, auction fee systems or schedules were highly varied, but most of them used systems of fees based either on the size of packages or types of commodities.

The range in auction fees paid by growers in 1936 at the 60 auctions where such charges were made, was from 0.14 to 5.13 cents per dollar of sales, and the average auction fee paid by growers was about two cents per dollar of sales.

There was considerable variation between States in the size of auction fees paid by growers per dollar of sales. The average auction fee paid by growers at 14 northern auctions was about 2.7 cents per dollar of sales (table 11). Auction fees paid by growers at 46 southern auctions were appreciably lower, and averaged only about 1.6 cents per dollar of sales.

TABLE 11. AUCTION FEES PAID BY GROWERS PER DOLLAR OF SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

State	Auctions in State	Auctions at which fees were paid by growers	Average auction fees per dollar of sales
	Number	*Number*	*Cents*
Northern States:			
Massachusetts, Connecticut, and New York combined	5	5	2.78
New Jersey	9	9	2.64
Total or average	14	14	2.69
Southern States:			
Delaware	6	5	1.60
Maryland	10	8	1.37
Virginia	18	18	0.86
North Carolina	13	12	2.10
South Carolina and Florida combined	3	3	1.24
Total or average	50	46	1.56

FEES PAID BY BUYERS

Auction fees charged buyers were of much less importance as a source of income than were fees paid by growers, and only 10 of the 64 auctions charged buyers such fees. Five auctions, located on the Eastern Shore of Virginia, made an 8-cent-per-crate charge to buyers of strawberries. In return for this charge, the auctions performed various services for the buyers, such as keeping their accounts with the growers, paying growers weekly by check, and checking and inspecting growers' loads when transferred to buyers' trucks. In Virginia, fees paid by buyers *were* the most important source of income to the auctions. Auction fees charged buyers by the 10 auctions in 1936 varied from 0.57 to 4 cents, and averaged about 1.5 cents per dollar of sales.

BROKERAGE FEES PAID BY OUTSIDE BUYERS

Income realized from brokerage fees[9] paid by outside buyers to local buyers, who either own or help control auctions, would not ordinarily be considered by the local buyers (who actually receive the fees) as a source of income to the auctions. At most of the auctions where such fees were charged, however, these local buyers owned and controlled the auctions either partially or entirely. Consequently, the fees charged outside buyers for the privilege of buying on the auctions were, for all practical purposes, a source of income to those who operated the auction. Of approximately $250,000 of gross income received by all auctions, brokerage fees paid by outside buyers made up almost $64,000 (or about one-fourth); auction fees paid by buyers about $19,500 (or 8 per cent); and auction fees paid by growers were more than $165,000 (or about two-thirds of the gross income).

The range in brokerage fees paid by outside buyers to local buyers was from 0.09 to 3.61 cents, and averaged 1.32 cents per dollar of sales.

OTHER INCOME

Seven auctions had sources of income other than the three major sources already considered. At six of these auctions, the income was from lunchstands rented out as concessions. The annual rentals from lunchstands ranged from $91 per season at a Connecticut auction, to $216 at a New Jersey auction, and averaged approximately $143 each for the six auctions. A seventh auction, located in South Carolina, received annual rentals totaling $423 for office space rented to buyers in the auction building.

Two auctions refunded to growers a portion of the charges collected from them in 1936. One of these auctions returned nearly one-half of all charges it had collected from growers during the year. Because of an unusually large local crop of its principal commodity, this auction had a volume of business in 1936 more than double that of any previous season. Charges to growers were assessed at the same rate as in former years, and approximately $3400 of the charges collected were refunded.

NET INCOME

Consolidated reports for all 64 auctions of the income derived from all sources showed a gross income of $249,932, with refunds of $3565 of auction fees, leaving $246,367 net income for all auctions. For most purposes, however, the net income to auctions (not including as income brokerage fees paid by outside buyers) might be desired rather than the net income including such brokerage fees. The range in net income for 61 auctions (not including brokerage fees paid by outside buyers to local buyers) was from 0.14 to 6 cents per dollar of sales. For all of these 61 auctions, net income averaged 2.15 cents per dollar of sales (table 12).

EXPENSES[10]

The total deductions from the gross price paid at auction which resulted from the handling of produce by these country fruit and vegetable auctions

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[9] Fees paid by buyers who for any reason (usually inability to establish a credit rating, or monopoly in the control of the auction by certain local buyers) were either required to buy, or found it to their financial advantage to buy through some local buyer.

[10] The term *expenses* has been used in this analysis rather than *costs* or *operating costs* because it was possible to obtain balance sheets from only a few of the auctions; and therefore, interest on average net worth has not been considered. An item of expense has been included for interest on average investment in physical facilities (buildings, land, equipment, and office supplies), but this would not be the same as interest on average net worth for all auctions.

TABLE 12. NET INCOME PER DOLLAR OF SALES, EXCLUDING BROKERAGE FEES PAID BY OUTSIDE BUYERS TO LOCAL AUCTION BUYERS, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

State	Auctions in State	Auctions with income other than brokerage fees	Average net income per dollar of sales (excluding brokerage fees paid by outside buyers)
	Number	*Number*	*Cents*
Northern States:			
Massachusetts, Connecticut, and New York, combined	5	5	2.44
New Jersey	9	9	2.79
Total or average	14	14	2.68
Southern States:			
Delaware	6	5	1.62
Maryland	10	8	1.37
Virginia	18	18	2.21
North Carolina	13	13	2.08
South Carolina and Florida, combined	3	3	1.48
Total or average	50	47	1.84

ranged from 0.73 to 7.11 cents per dollar of sales. At four of these auctions, total deductions from gross price were less than one cent per dollar of sales; while at eight auctions, total deductions averaged 5.49 cents (table 13).

TABLE 13. TOTAL COSTS OF HANDLING FRUITS AND VEGETABLES PER DOLLAR OF GROSS SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936*

Range in total costs per dollar of sales	Auctions in each group		Average total cost per dollar of gross sales
		Percentage of total	
Cents	*Number*	*Per cent*	*Cents*
Less than 1	4	6	0.87
1–1.99	20	31	1.69
2–2.99	12	19	2.64
3–3.99	15	23	3.40
4–4.99	5	8	4.45
5 or more	8	13	5.49

*Does not include items of *other income.*

For practical purposes, items of expense incurred by these 64 country auctions may be segregated into four groups: (1) personnel, which averaged $1205 per auction; (2) property, which averaged $238; (3) supplies and services, $128; and (4) miscellaneous, $118 (table 14).

PERSONNEL

Since all of the auction employees had some definite and active duty to perform when the auction was in operation and such duty usually involved labor, it seemed impracticable to classify the wages of certain of the employees as *salaries,* and those of others as *labor expense.* The term *personnel expense* seems to describe most nearly accurately the items involved. Personnel expense included wages paid to auctioneers, managers, inspectors, auction clerks, office clerks, and other employees, as well as employees' liability insurance.

The ratio of personnel expense to total expense ranged from about 58 per cent in the South Carolina - Florida area, to about 85 per cent in Virginia, and averaged about 71 per cent for all 10 States (table 32, appendix).

TABLE 14. AVERAGE COMBINED INCOME AND EXPENSE STATEMENT FOR 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Item	Weighted average per auction	Auctions having each item	
			Average
	Dollars	*Number*	*Dollars*
Income:			
Auction charges to growers	2,583	60	2,755
Auction charges to buyers	305	10	1,953
Brokerage fees paid by outside buyers	997	38	1,679
Other income	20	7	183
Gross income	3,905	64	3,905
Auction charges refunded to growers	–56	2	–1,782
Net income	3,849	63	3,911
Expenses:			
Personnel:			
Auctioneer	381	63	387
Manager	188	24	502
Inspectors	188	11	1,091
Auction clerk	141	42	215
Office clerks	129	24	343
Other employees	171	36	304
Employees' liability insurance	7	7	64
Total personnel expense	1,205	64	1,205
Property:			
Interest on investment in physical facilities at 5 per cent	72	61	76
Repairs and construction	60	27	141
Depreciation on buildings	43	55	50
Rent	31	30	66
Insurance	16	18	55
Taxes	9	13	45
Depreciation and purchases of equipment	7	10	43
Total property expense	238	64	238
Supplies and services:			
Office supplies	48	31	101
Bank service	23	2	751
Auction supplies	21	24	55
Telephone and telegraph	21	26	52
Light and heat	11	17	40
Other	4	8	28
Total service expense for supplies and services	128	54	152
Miscellaneous:			
Miscellaneous operating expense	62	46	87
Traveling expense	25	9	182
Advertising and publicity	10	12	53
Bad debts	7	3	148
Interest on borrowed money	5	5	68
Miscellaneous office expense	4	8	28
Other	5	3	98
Total miscellaneous expense	118	50	152
Total expense	1,689	64	1,689
Net profit	2,160	60	2,305
Net profit (exclusive of brokerage fees paid by outside buyers)	1,163	50	1,490

Wages paid to auctioneers (figure 8) varied from about 15 per cent of the total expense in New Jersey, to nearly 45 per cent in Maryland, and averaged about 23 per cent for all 10 States. All but one of the auctions employed auctioneers in 1936.

Twenty-four auctions employed individuals in the capacity of managers in 1936. Some other employee acted in this capacity at other auctions. Wages to managers hired or appointed as such, ranged from zero to 16 per cent.

Eleven auctions employed inspectors. Wages or fees paid to inspectors varied from zero to about 36 per cent. Since only one auction in the northern States employed inspectors in 1936, the proportion of total expense made up by this item was only about 5 per cent in these States, as compared with about 21 per cent in the 6 southern States (table 32, appendix).

Forty-two auctions employed auction clerks. The proportion of total expense made up of wages to auction clerks was from approximately 4 per cent to nearly 17 per cent.

Twenty-four auctions employed office clerks. The proportion of total expense made up of wages to office clerks varied from a little less than 2 per cent to about 11 per cent.

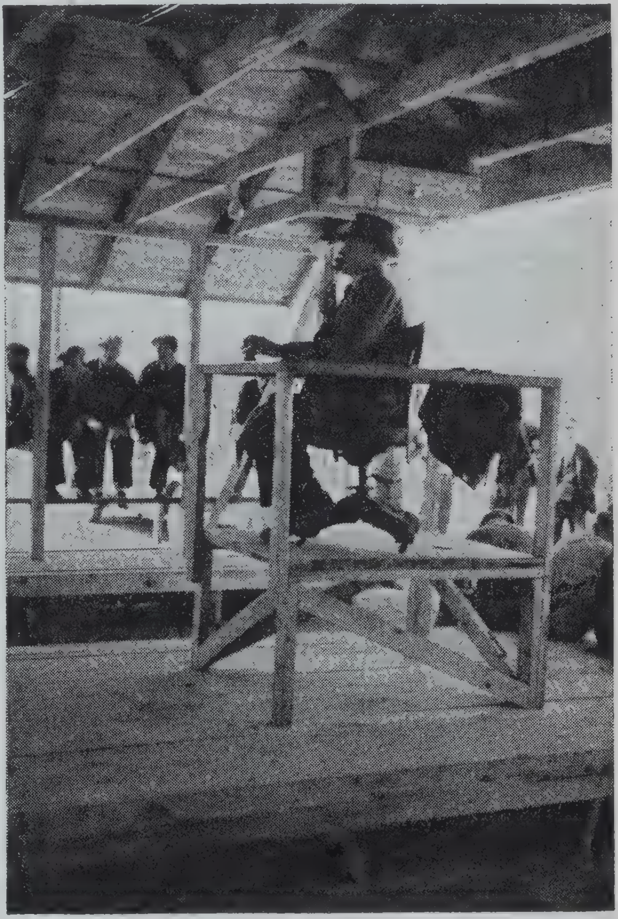

FIGURE 8. AUCTIONEER AT WALLACE, NORTH CAROLINA

All but one of the 64 auctions employed auctioneers in 1936

Thirty-six auctions had employees other than those listed above, and these accounted for 10 per cent of the expense. The range in total expense made up by wages to "other employees" was from a little less than 5 per cent in Maryland and Delaware to about 27 per cent in Virginia.

PROPERTY

Property expense varied from 5.8 per cent of all costs in Virginia to almost 40 per cent in the South Carolina - Florida area, and averaged about 14 per cent for the entire 64 auctions (table 32, appendix).

SUPPLIES AND SERVICES

Supplies and services accounted for about 2 per cent in the South Carolina - Florida area, and about 13 per cent in North Carolina, with an average of almost 8 per cent for all areas (table 32, appendix).

Country auctions seem to be relatively inexpensive to operate. Total expenses per dollar of sales for all auctions ranged from one-tenth of one cent to 5.15 cents, and averaged about 1.2 cents per dollar of sales. The wide range in total expense per dollar of sales, however, may indicate the likelihood that some auctions could lower their expenses considerably, without reducing the services performed. This variation was caused largely by differences in the amount of services offered growers by auctions in the various areas.

For the 14 auctions in 4 northern States, the average total expense was slightly more than two cents per dollar of sales (table 15). In contrast to this, total expense for the 50 auctions in the 6 southern States averaged less than three-fourths of a cent per dollar of sales, or about one-third as much as at the 14 auctions in 4 northern States. Auctions in Delaware showed the lowest average total expense — 0.3 of a cent per dollar of sales.

TABLE 15. TOTAL EXPENSE PER DOLLAR OF SALES FOR 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 1936

State	Auctions	Total expense per dollar of sales
	Number	*Cents*
Northern States:		
Massachusetts, Connecticut, and New York combined	5	1.74
New Jersey	9	2.18
Total or average	14	2.04
Southern States:		
Delaware	6	0.26
Maryland	10	0.48
Virginia	18	0.67
North Carolina	13	1.15
South Carolina and Florida combined	3	0.70
Total or average	50	0.73

FACTORS RELATED TO EXPENSE PER DOLLAR OF SALES

Many factors seem to have been related in some degree to total expense per dollar of sales, and all factors seem to bear a joint relationship to this expense. Even though a relationship may seem to exist between an individual factor and the total expense per dollar of sales, it is difficult to demonstrate that it was not caused indirectly by some other factor. Some of the factors which seemed more or less related to expense per dollar of sales were: (1) volume of sales per auction; (2) number of commodities handled; (3) length of operating season; (4) efficiency in use of labor; and (5) type of ownership.

VOLUME OF SALES

In the 4 northern States, the 5 auctions with the lowest average sales (about $68,000 per auction) had an average total expense of 3.1 cents per dollar of sales, while the 4 auctions with the highest average sales (nearly $490,000 per auction) had an average total expense of only about 1.6 cents per dollar of sales (table 16).

In the 6 southern States, the 17 auctions with the lowest average sales (slightly less than $24,000 per auction) had average expenses of 1.03 cents per dollar of sales, while the 16 auctions with the highest average sales (nearly $260,000 per auction) had an average total expense of 0.7 of a cent

TABLE 16. RELATION OF VOLUME OF FRUIT AND VEGETABLE SALES TO EXPENSE PER DOLLAR OF SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Range in annual gross sales per auction	Average gross sales per auction	Auctions in group	Average expense per dollar of gross sales
Dollars	*Dollars*	*Number*	*Cents*
Northern States:			
Less than 115,000	68,130	5	3.10
115,000–300,000	209,424	5	2.51
Over 300,000	448,799	4	1.58
Southern States:			
Less than 50,000	23,566	17	1.03
50,000–135,000	79,396	17	0.75
Over 135,000	257,857	16	0.70

per dollar of sales. These data would seem to indicate that large volume of sales per auction was associated with low costs of operation. It is probable that the 16 southern auctions, with largest volumes, would have had even lower costs if their average investment in physical facilities had been more in line with the other 34 auctions in that area.

NUMBER OF COMMODITIES HANDLED

In the 4 northern States, the 5 auctions which handled the fewest commodities (about 10 per auction) reported the lowest total expense (1.5 cents) per dollar of sales (table 17). The two groups which averaged 16 or more commodities per auction had expenses per dollar of sales of about 2.4 cents. The major reason for the differences seems to have been in length of operating season. The auctions handling 26 or more commodities developed somewhat larger sales, but did it at the expense of higher costs for labor through stretching out the season to 204 operating days.

In the 6 southern States, the 20 auctions which handled only one commodity had the highest total expense per dollar of sales (0.95 cent); and the group of 18 auctions which averaged three commodities per auction had the lowest total expense per dollar of sales (0.58 cent).

The southern auctions handling only one commodity had the lowest volume of sales per auction and by far the shortest operating season. Al-

TABLE 17. RELATION OF NUMBER OF COMMODITIES HANDLED TO EXPENSE PER DOLLAR OF SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Commodities handled: Range	Commodities handled: Average per auction	Auctions in group	Average expense per dollar of sales	Average length of operating season
	Number	*Number*	*Cents*	*Days*
Northern States:				
15 or less	10	5	1.50	117
16–25	22	4	2.39	140
26 or more	39	5	2.35	204
Southern States:				
1	1	20	0.95	23
2–4	3	18	0.58	67
5 or more	7	12	0.80	106

though the group handling 5 or more commodities was able to increase volume of business over the 2-to-4-commodities group, the gain in volume seems to have been brought about only by a much longer operating season, with relatively high costs for labor. Merely handling a large number of commodities did not result in lowest operating costs either in the northern or the southern States. Unless substantial quantities of each commodity can be handled each day of operation, it may be an uneconomical venture to add more commodities to the list to be handled.

LENGTH OF OPERATING SEASON

It seems logical to believe that the longer an auction can be operated, with *substantial volume* per day of operation, the lower will be the cost of operation. It does not follow, however, that merely operating the auction for a long period will insure low costs. Of the 14 northern auctions, the 5 which had the shortest operating season (an average of about 65 days) had the lowest total expense (1.34 cents) per dollar of sales, while the group which operated an average of 276 days had expenses averaging 2.77 cents per dollar of sales. The average sales per day approximated $3245 for the first group, and only $830 per day for the second group (table 18).

TABLE 18. RELATION OF LENGTH OF OPERATING SEASON TO EXPENSE PER DOLLAR OF SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Length of operating season		Auctions in group	Average expense per dollar of sales	Average volume of sales per day of operation
Range	Average per auction			
Days	*Days*	*Number*	*Cents*	*Dollars*
Northern States:				
Less than 120	65	5	1.34	3,245
120–175	147	5	2.11	1,649
Over 175	276	4	2.77	830
Southern States:				
25 or less	21	17	0.97	2,850
26–74	49	16	0.66	2,268
75 or more	106	17	0.70	1,709

Of the 50 southern auctions, the 17 with the shortest operating season (an average of only 21 days) had the highest total expense (0.97 cent) per dollar of sales, but also had the largest average sales per day of operation. For the remaining 16 auctions, there seemed to be little difference in expenses of operation whether they operated 49 or 106 days, but the expense of operation was only two-thirds as great per dollar of sales as in the case of the auctions which operated about 21 days. The fact that the 17 with the highest expenses were one-commodity auctions may explain why expenses were so high. Labor expense seems to have been much higher on single-commodity auctions than on those which handled 3 to 5 commodities.

The southern auctions which handled from 3 to 5 commodities seem to have been able to develop from two to three times as great a volume of business as the single-commodity auctions, and to have used its personnel more efficiently.

LABOR EFFICIENCY

Efficient use of personnel should logically be a vital factor in reducing expenses of operation. In both northern and southern States, the auctions which had the largest sales per dollar expended for personnel hire likewise had the lowest total expense of operation per dollar of sales (table 19).

TABLE 19. RELATION OF LABOR EFFICIENCY TO TOTAL EXPENSE PER DOLLAR OF SALES, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936*

Sales per dollar of personnel expense: Range	Sales per dollar of personnel expense: Average per auction	Auctions in each group	Average total expense per dollar of sales
Dollars	*Dollars*	*Number*	*Cents*
Northern States:			
Less than 40	36	5	3.95
40–84	74	4	2.18
85 or more	116	5	1.23
Southern States:			
Less than 118	89	17	1.29
118–210	154	16	1.02
Over 210	396	17	0.31

*Labor efficiency is here measured by gross sales of fruits and vegetables per dollar of personnel expense.

This is probably another way of saying that it is difficult to make efficient use of labor with a relatively small volume of sales, and that costs rise rapidly when enough business is not done to keep the personnel busy.

TYPE OF OWNERSHIP

All of the 14 northern auctions were cooperatively owned, and it was not possible to compare them with privately owned auctions, since none could be found in these States. These northern cooperative auctions performed many services for growers not offered by southern auctions. These services included making collections from buyers and the assumption of credit risks, which entailed a certain amount of loss from uncollectible accounts. Average cost per dollar of sales in the 4 northern States was 2.04 cents.

The services performed by the 50 southern auctions were practically identical, whether the auctions were cooperatively or privately owned. The 37 private or municipal auctions, located in the southern States, reported an average total expense per dollar of sales of 0.8 cent. The average total expense per dollar of sales for the 13 cooperative auctions was 0.54 cent per dollar of sales. The average volume of sale for all private auctions was $117,428, and for the southern cooperatives $117,785. The cooperatives had only $333 invested in physical facilities as compared with $802 for private auctions. The cooperatives operated an average of 42 days as compared with 65 for private auctions. Cooperatives also seem to have made more efficient use of labor, since sales per dollar of personnel expense were $226 for cooperatives and $165 for private or municipal auctions. It thus appears that cooperative auctions have been more than able to hold their own in these southern States.

USE OF AUCTIONS BY GROWERS

Since growers usually have alternative methods of sale from which to choose, their general appraisal of the auction method of marketing may be an important factor in determining the probable future of such auctions. Probably the best way to learn the attitudes of growers towards auctions is to find out what use they actually have made of them.

To determine the relative use of auctions by growers, data were obtained from 431 growers, 128 of whom were located in 4 northern States, and 303 in 6 southern States (figure 9). Every effort was made to obtain data from a sufficient number of growers in the vicinity of each auction to reflect the general attitude of growers toward auction marketing as accurately as possible.

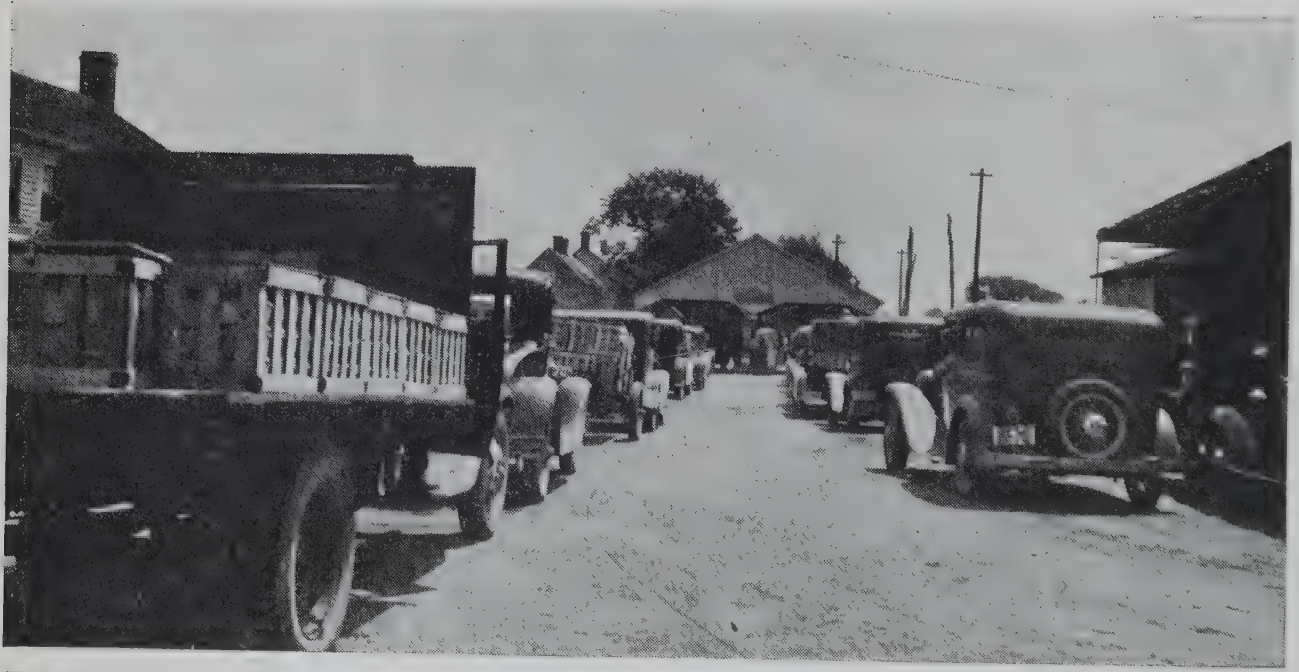

FIGURE 9. SCENE AT PITTSVILLE, MARYLAND, AUCTION, SHOWING LONG LINE OF GROWERS AWAITING TURN TO SELL PRODUCE AT THE AUCTION

DISTANCE TO AUCTIONS

One of the purposes of this study was to learn the extent to which the auction method of sale was used by growers within areas actually served by auctions.

The size of the area served was not identical for any two auctions. A 10-mile radius was arbitrarily selected as the maximum, within which it would be reasonable to assume that all growers producing commodities (which might have been sold at auction) could have used such an auction. Some auctions did not serve an area as large as that included in a 10-mile radius. Under such conditions, only growers whose farms were located within the small area, which such an auction could have served, were included. Because of the overlapping of auction territories, a few of the growers were located more than 10 miles from the auction which they patronized. For example, a grower located within 10 miles of one auction might not have had any of the commodities which were handled by the nearest auction, and might, therefore, have patronized a second auction located more than 10 miles from his farm.

Approximately 60 per cent of these growers lived less than 4 miles from auctions handling some commodity they sold during 1936 (table 20). About 18 per cent were located one mile distant; about 25 per cent, 2 miles; and another 18 per cent, 3 miles from the auctions. About one-third of all these growers lived from 4 to 7 miles from the auctions at which they sold some commodity or commodities during 1936.

TABLE 20. RELATIVE DISTANCE FROM FARM TO AUCTION, AS REPORTED BY 431 GROWER-PATRONS, 10 EASTERN SEABOARD STATES, 1936

Distance to nearest auction*	Growers in group	Proportion of growers so located
Miles	*Number*	*Per cent*
1	76	17.6
2	109	25.4
3	76	17.6
4	74	17.2
5	36	8.4
6	20	4.6
7	14	3.2
8	5	1.2
9	4	0.9
10	7	1.6
11	4	0.9
12	3	0.7
13	3	0.7
Total	431	100.0

*Which handled one or more commodities sold by the grower.

VOLUME OF SALES

The average sales of fruits and vegetables by these 431 growers amounted to about $2600 per grower in 1936. About 50 per cent of these growers reported fruit and vegetable sales of less than $1500 per grower, and only 12 per cent sold more than $5000 worth in 1936.

Growers in northern States averaged approximately $3500 each in volume of fruit and vegetable sales during 1936. Growers in southern States averaged less than $2200 each for such sales.

COMMODITIES SOLD AT AUCTIONS

Of 431 growers, 375, (or 81 per cent) sold some fruits and vegetables at country auctions in 1936. Their total sales at auction exceeded $350,000, or about $950 per grower. A little more than $140,000 of this total volume, or about $1457 per grower, was sold by 96 growers in the 4 northern States; and about $216,000, or about $739 per grower, by 279 growers in the 6 southern States (table 21).

Strawberries were the most important commodity sold, making up about 18 per cent of the total value of all commodities sold at auction by these growers in 4 northern States, and about 50 per cent in 6 southern States.

String beans, Irish potatoes, lima beans, cantaloupes, cauliflower, and cucumbers, in the order mentioned, were next in importance. Irish potatoes and cauliflower were much more important in northern States than in southern States; string beans, cantaloupes, and cucumbers were more important in southern States than in northern States. Together with strawberries, these six commodities made up nearly 80 per cent of the total value of all fruits and vegetables sold at auction by the 375 growers.

RELATIVE USE OF AUCTIONS

In the 4 northern States, 96 growers (about 75 per cent) sold some produce at country fruit and vegetable auctions during 1936; and in the 6 southern States, 279 growers (about 92 per cent made use of auctions.[11]

TABLE 21. LEADING COMMODITIES SOLD AT AUCTION, AS REPORTED BY 375 GROWERS, 10 EASTERN SEABOARD STATES, 1936*

Commodity	Total auction sales in			Proportion of total auction sales in		
	4 northern States	6 southern States	Total	4 northern States	6 southern States	Total
	Dollars	*Dollars*	*Dollars*	*Per cent*	*Per cent*	*Per cent*
Strawberries	23,432	108,399	131,831	18	50	38
String beans	5,992	27,681	33,673	4	13	9
Irish potatoes	17,278	12,925	30,203	12	6	8
Lima beans	9,047	12,984	22,031	6	6	6
Cantaloupes	637	20,481	21,118	‡	10	6
Cauliflower	20,632	......	20,632	15	..	6
Cucumbers	812	15,860	16,672	1	7	5
Peaches	11,205	......	11,205	8	..	3
Green peppers	3,634	4,101	7,735	3	2	2
Tomatoes	5,703	1,643	7,346	4	1	2
Dry onions	7,143	......	7,143	5	..	2
Apples	5,597	......	5,597	4	..	2
Blackberries	4,850	......	4,850	3	..	1
Sweet potatoes	4,753	42	4,795	3	‡	1
Broccoli	537	3,212	3,749	‡	1	1
Dewberries	......	3,628	3,628	..	2	1
Green peas	769	2,772	3,541	1	1	1
Raspberries	3,099	......	3,099	2	..	1
Sweet corn	1,492	1,275	2,767	1	1	1
Cabbage	2,616	48	2,664	2	‡	1
Miscellaneous commodities†	11,452	962	12,414	8	‡	3
Total	140,680	216,013	356,693	100	100	100

*Commodities which made up one per cent or more of the total auction sales of all commodities in the 10 States.

†Includes all commodities not among the leading twenty; in order of importance they were: carrots, brussels sprouts, watermelons, beets, lettuce, eggplant, pears, grapes, radishes, parsley, spinach, squash, dandelion greens, cherries, holly wreaths, currants, green onions, okra, leeks, parsnips, chicory, celery, turnips, asparagus, scallions, and pumpkins.

‡Less than one per cent.

When *all* produce was considered, only 32 per cent of the fruit and vegetable sales reported by these 431 growers was disposed of at country auctions in 1936. The percentage sold was about the same in the northern and in the southern States. When, however, only those sales which could have been made at an auction within 10 miles of the farm were considered, the proportion sold by this method was 60 per cent in the South and 39 per cent in the North.

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[11] It should be borne in mind that data were obtained only from growers within areas actually served by country fruit and vegetable auctions, and within these areas, only from growers who raised some commodity of the kind handled by an auction within 10 miles of their farms. The proportion of growers in any area who actually sold fruits and vegetables at country auctions would, of course, be much lower were it not for these limitations. The limitations were necessary to determine the proportion of growers that might reasonably be expected to use country fruit and vegetable auctions, who were actually using them.

LENGTH OF SERVICE THROUGH AUCTIONS

The periods during which these 375 growers used auctions during 1936 ranged from 1 to 100 days, and averaged about 23 days. The 96 growers in 4 northern States patronized auctions about 35 days during the year. The 279 growers in 6 southern States used auctions an average of about 18 days during 1936.

GROWERS' ATTITUDES TOWARDS AUCTIONS

About 16 per cent of these 431 growers seemed to have had a highly favorable attitude toward auctions. The attitudes of a much larger proportion (58 per cent) might be classified as reasonably favorable; about 13 per cent seemed to be somewhat indifferent; and 13 per cent registered varying degrees of opposition to country auctions as a means for selling fruits and vegetables satisfactorily.

What growers think may be one thing, and what they do may be something else. Probably the best test of the attitudes of these growers is what they did during 1936. All the growers with "highly favorable" attitudes toward country auctions patronized them in 1936, as did about 97 per cent of the growers who had reasonably favorable attitudes. However, in spite of their attitudes, about two-thirds of the growers who were indifferent towards auctions actually patronized them; and approximately one-half of those who were opposed to auctions also used them to some extent. Growers with "highly favorable" attitudes towards auctions sold 47 per cent (in dollars) of their fruits and vegetables through auctions, while only 10 per cent of their fruit and vegetable sales were made through auctions by growers listed as "opposed".

DISTANCE FROM AUCTIONS

Distance growers lived from auctions likewise affected the proportion of growers selling at country auctions. Distances up to 5 miles did not seem to affect the proportion of growers selling at auction, since just as large a proportion (89 per cent) of growers living 5 miles away patronized the auctions as of those living less than 3 miles away (table 22). Distances of more than 7 miles, however (none farther than 13 miles), appreciably reduced the proportion of growers selling at auctions.

TABLE 22. DISTANCE FROM FARM TO NEAREST AUCTION* RELATED TO GROWERS' USE OF AUCTIONS, AS REPORTED BY 431 GROWERS, 10 EASTERN SEABOARD STATES, 1936

Distance to nearest auction	Growers interviewed	Growers who used auctions		Proportion of growers' total fruit and vegetable sales made at auction
			Percentage of total	
Miles	*Number*	*Number*	*Per cent*	*Per cent*
Less than 3	185	165	89	33
3–4.9	150	134	89	34
5–6.9	56	47	84	31
7 or more	40	29	72	22
Total or average	431	375	87	32

*Which handled one or more commodities the growers sold.

SIZE OF GROWER'S BUSINESS

It has been generally assumed that growers with large acreages made relatively little use of country fruit and vegetable auctions, and that one of the most acute problems confronting country auctions has been to develop services that would appeal to such growers.

If these assumptions are correct, the patronage of country auctions would have to consist largely of growers who are small operators. The facts indicate, however, that approximately as large a proportion (about 77 per cent) of the growers with 50 acres or more of fruits and vegetables in 1936 sold at country auctions, as did growers with less than 5 acres (78 per cent) (table 23). It was true, however, that the proportion of all produce which was sold at auction, decreased markedly as the size of the grower's business increased, but it is obvious that the volume marketed from only 18 per cent of 50 or more acres would be greater than the volume from 61 per cent of three acres. If these data are representative, it would seem that the patronage of growers operating on a large scale, therefore, was relatively more important to country auctions than that of growers whose business was small. Generally speaking, something over half of the patronage and income at these auctions came from growers with acreage above the average.

TABLE 23. RELATION OF SIZE OF GROWER'S BUSINESS, AS MEASURED BY ACRES OF FRUITS AND VEGETABLES GROWN, TO USE OF AUCTIONS, AS REPORTED BY 431 GROWERS, 10 EASTERN SEABOARD STATES, 1936*

Acreage of fruits and vegetables	Growers interviewed	Growers who used auction		Proportion of grower's total fruit and vegetable sales made at auction
			Percentage of total	
Acres	*Number*	*Number*	*Number*	*Per cent*
Less than 5	50	39	78	61
5– 9.9	113	96	85	47
10–14.9	72	66	92	47
15–24.9	88	82	93	32
25–49.9	78	69	88	33
50 or more	30	23	77	18
Total or average	431	375	87	32

*These 431 growers raised an average of about 20 acres of fruits and vegetables per grower in 1936. The 128 growers interviewed in 4 northern States raised an average of 27 acres, while the 303 growers in 6 southern States averaged only about 17 acres each.

When growers' operations were measured by their gross sales in dollars of fruits and vegetables in 1936, the same relationship was observed. A slightly higher percentage of growers, whose fruit and vegetable sales totaled $5000 or more, used country auctions, than of growers whose fruit and vegetable sales were less than $500 (table 24). On the other hand, sales at country auctions averaged 56 per cent of total sales by growers who sold less than $500 worth of fruits and vegetables, and only 22 per cent for the group whose total sales aggregated $5000 or more.

PLACE OF SALE

Total fruit and vegetable sales at all markets by these 431 growers amounted to $1,108,505. Of this total, about 32 per cent was sold at country auctions, about 30 per cent at small local markets other than country auctions, 23 per cent at the farm, and 15 per cent at large city markets.

TABLE 24. RELATION OF SIZE OF GROWER'S BUSINESS, AS MEASURED BY GROSS SALES OF FRUITS AND VEGETABLES, TO USE OF AUCTIONS, AS REPORTED BY 431 GROWERS, 10 EASTERN SEABOARD STATES, 1936

Range in gross sales of all fruits and vegetables	Growers interviewed	Growers who used auctions		Proportion of grower's total fruit and vegetable sales made at auction
			Percentage of total	
Dollars	*Number*	*Number*	*Per cent*	*Per cent*
Less than 500	77	64	83	56
500– 999	63	53	84	53
1,000–1,499	78	68	87	52
1,500–2,499	68	62	91	45
2,500–4,999	90	80	89	32
5,000 or more	55	48	87	22
Total or average	431	375	87	32

Gross sales per grower averaged $1483 at the farm, $1321 at other small local markets, $1061 at large city markets, and $951 per grower at auctions.

Of the total fruits and vegetables sold by the 431 growers in 1936, not more than 64 per cent could have been sold at auctions within a reasonable distance of the farm. Of the portion which could have been sold at auction within a reasonable distance, about half was actually sold at auction (table 25). The average proportion of total volume sold at auctions (60 per cent), and at local markets (23 per cent) in the southern States was considerably greater than in the northern States, where much larger percentages were sold at large city markets (33 per cent), and at the farm (19 per cent).

TIME SPENT SELLING AT AUCTIONS

The 375 growers who patronized auctions spent, on the average, a little less than an hour selling a load of produce at auction from the time they left their farms until they returned. In the northern States, the average was about an hour and a quarter, and in the southern States about 50 minutes.

About 12 per cent of the southern growers spent as little as 15 minutes, and about a third spent only 30 minutes in selling a load at auction. More than four-fifths of the growers in the southern States required an hour or less to sell at auction. In the northern States, about 62 per cent spent an hour or less, and about 38 per cent more than an hour.

Comment that the time required to sell a load at auction was excessive came mostly from growers in New Jersey. On the average, nearly an hour and a half was spent selling a load at auction in this State, and growers reported that it was often necessary to spend three hours at some of the larger auctions.

WHY GROWERS USED AUCTIONS

Approximately 58 per cent of the 375 growers indicated that "higher net returns" was the major reason why they used auctions (table 33, appendix). Nearly one-fifth of the growers indicated that, in their localities, the auction was the "only practical or reasonable method of sale available;" about 14 per cent were of the opinion that there was "less risk in selling"

TABLE 25. PLACE OF SALE OF ALL FRUITS AND VEGETABLES,* AS REPORTED BY 431 GROWERS, 10 EASTERN SEABOARD STATES, 1936

Place of sale	Proportion of total fruit and vegetable sales									
	Massachusetts, Connecticut, and New York combined	New Jersey	4 northern States	Delaware	Maryland	Virginia	North Carolina	South Carolina and Florida combined	6 southern States	Total 10 States
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Country fruit and vegetable auctions..	50	34	39	90	82	34	61	58	60	50
Local markets other than country auctions........................	6	11	9	2	2	48	12	41	23	16
Large city markets................	13	41	33	4	13	10	21	1	12	22
At farm........................	31	14	19	4	3	8	6	..	5	12
Total......................	100	100	100	100	100	100	100	100	100	100

*Which might possibly have been sold at some auction within 10 miles of farm.

at auctions; and about one-eighth preferred to use auctions because they "see their own produce sold, and know what they get when they sell."

WHY GROWERS DID NOT USE AUCTIONS

Of the 56 growers who did not sell at auction in 1936, more than half gave "lower net returns than other methods of sale available" as the reason; and about one-fifth said that auctions were "less convenient than other methods of sale available." Another one-fifth had a "dislike of auction owners, buyers or personnel;" and nearly one-fifth were "reluctant to change from present method of sale." Slightly more than 10 per cent of these growers explained that they "did not have enough produce to bother hauling to auction," and about the same percentage that "auctions cannot handle produce in large lots."

USE OF AUCTIONS BY BUYERS

If these auctions are to be successful, they must be able to induce a sufficient number of buyers to patronize the auction consistently so as to insure competitive bidding. To do this effectively, the wishes and requirements of buyers must be known and met insofar as it is practicable. For this reason, data were obtained directly from 114 auction buyers who made purchases at 62 of the 64 auctions. Whenever possible, at least three buyers at each auction were included (figure 10).

About 31 per cent of these buyers made purchases at only one auction, 17 per cent at two auctions, 12 per cent at three, 13 per cent at four, and about 27 per cent at five or more auctions. On the average, these buyers

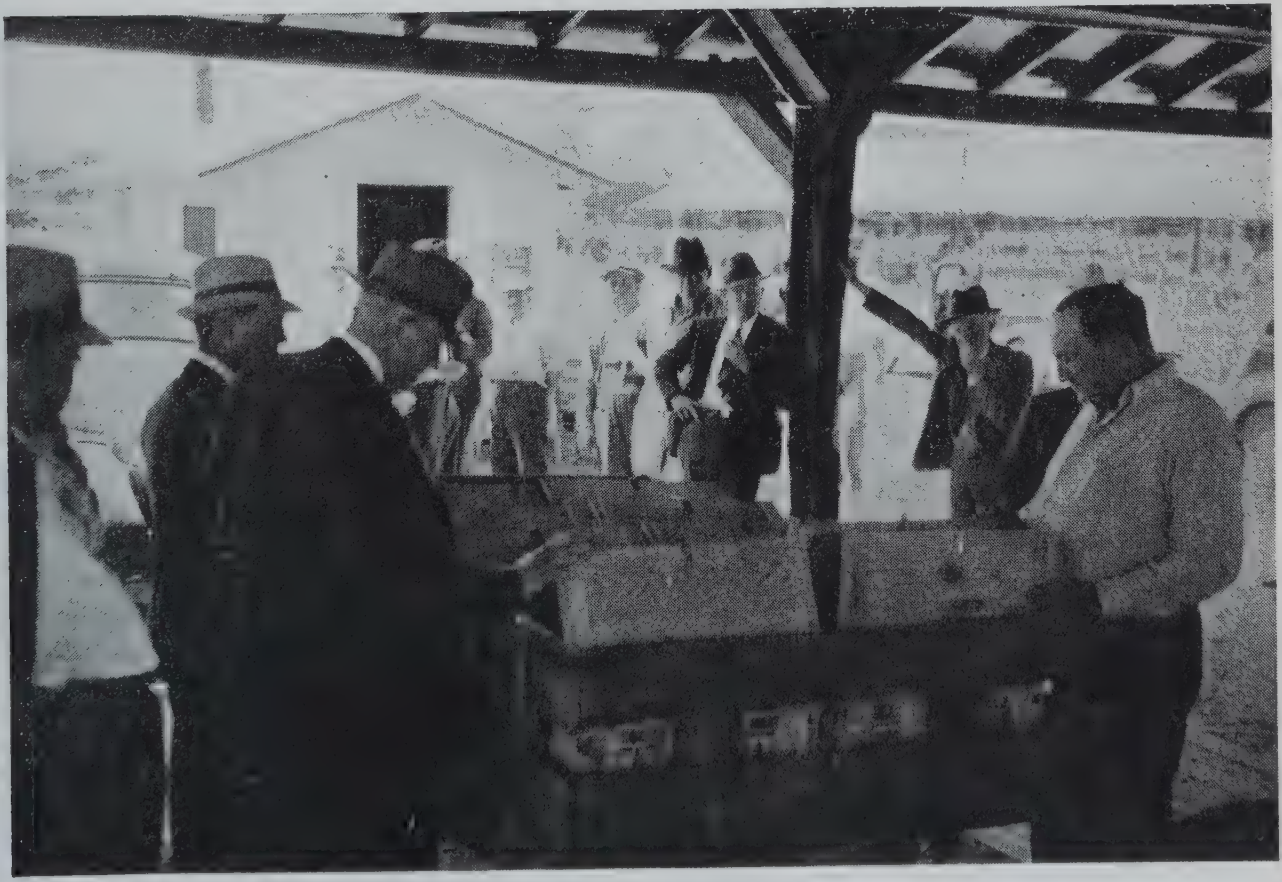

FIGURE 10. SCENE AT CHADBOURN, NORTH CAROLINA, AUCTION
Buyers from North Carolina, Maryland, and New Jersey inspecting offering of strawberries

made purchases at four auctions in 1936. The maximum number of auctions patronized by any northern buyer was five, and by any southern buyer, fourteen.

LOCATION OF BUYERS

Of the 114 buyers interviewed, 83 per cent had temporary or permanent headquarters within a mile of the nearest auction they patronized in 1936. Only 10 were as far as two miles, and only 9 buyers were located three miles or more from the nearest auction.

VOLUME OF BUSINESS FROM ALL SOURCES

The total fruit and vegetable purchases by these buyers from all sources approximated about 12 million dollars during 1936. About 9 per cent of these buyers made annual purchases totaling more than $200,000 per buyer, but 58 per cent purchased less than $50,000 worth per buyer (table 34, appendix). The average total purchases of fruits and vegetables per buyer in the northern States were approximately $48,000, and in the southern States about $112,700.

PROPORTION OF TOTAL PURCHASES AT AUCTION

Approximately 12 per cent of these buyers bought all of their fruit and vegetable supplies at auction, and about one-third estimated that they bought 80 per cent or more at auction. On the other hand, 17 per cent of the buyers estimated that they purchased less than 40 per cent of their total dollar volume of fruits and vegetables at auction.

TYPES OF BUYERS

More than three-fourths of these 114 auction buyers were country dealers. Of the remainder, 15 were merchant truckers, 7 were city wholesalers or jobbers, 3 were representatives of commission houses, one was a retailer, and one represented a cannery.

Representatives of city commission houses estimated that they obtained at auction 71 per cent of the total fruit and vegetables they purchased; merchant truckers and city jobbers or wholesalers, slightly more than two-thirds; country dealers, about 58 per cent; the retailer, about 48 per cent; and the cannery buyer, 10 per cent.[12] Average auction purchases per buyer were nearly $60,000, or about 58 per cent of total purchases per buyer (table 26).

OWNERSHIP RELATIONS OF BUYERS WITH AUCTIONS

About a third of the 114 buyers were part owners of one or more auctions in 1936, and another 5 per cent were full owners of one or more auctions. Those buyers who were neither owners nor part owners of any auction, bought about one-half of their total dollar volume of fruits and vegetables at auction. Those who were part owners of auctions bought about 72 per cent of their total fruit and vegetable purchases at auction; but those who

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[12] These percentage figures may be somewhat exaggerated. Since a large number of these buyers were full or part owners of auctions, they may have overestimated the proportion of their total purchases which was made at auctions.

TABLE 26. RELATION OF TYPE OF BUYER TO PROPORTION OF TOTAL FRUIT AND VEGETABLE PURCHASES AT COUNTRY AUCTIONS, AS REPORTED BY 114 BUYERS, 10 EASTERN SEABOARD STATES, 1936

Type of buyer	Buyers in group	Total purchases per buyer	Auction purchases per buyer	Proportion of total purchases at auction*
	Number	*Dollars*	*Dollars*	*Per cent*
Country dealer	87	114,988	66,296	58
Merchant trucker	15	41,974	28,593	68
City jobber or wholesaler	7	59,781	39,915	67
Commission-house representative	3	89,188	62,981	71
Retailer	1	6,466	3,105	48
Cannery	1	174,400	16,650	10
Average per buyer		101,913	59,447	58

*See footnote 12.

were full owners bought only about 41 per cent of their total purchases at auction.

BUYERS' ATTITUDES TOWARD AUCTIONS

About 89 per cent of these buyers seemed to have a favorable attitude toward auctions, about 8 per cent appeared somewhat indifferent, and 3 per cent were opposed. Most of the buyers who were indifferent or opposed were in New Jersey, Delaware, and Maryland.

DISTANCE BUYERS TRAVELED TO AUCTIONS

About 55 per cent of these 114 buyers traveled less than 25 miles to the most distant auction they patronized in 1936. The average for this group was only 6 miles, but about 19 per cent traveled an average of about 520 miles to the most distant auction at which they made purchases in 1936. The range in distance traveled was from 1 to 1085 miles.

The maximum number of miles traveled to the most distant auction by any buyer in the northern States was 105 miles. The maximum traveled by any buyer in Delaware was 970 miles; Maryland, 975 miles; South Carolina, 650 miles; and Florida, 1085 miles. Many Delaware, Maryland, and Virginia buyers went as far south as North Carolina to buy strawberries at country auctions, and a few patronized the auction at Wauchula, Florida.

The principal reason given by these buyers for traveling such long distances to country auctions was that they were able to obtain more advantageous terms from city wholesalers for midseason and late crops, if they supplied the wholesalers with early strawberries and other commodities from the southern States when the wholesalers were in greatest need of them. Most of the buyers insisted that they made very little profit handling early produce, but that it was necessary to do so if they wished to do business for the remainder of the year with city wholesalers. For such buyers, country auctions were the most convenient places to buy this early produce.

For buyers who traveled more than 25 miles to the most distant auction used, the greater the distance traveled, the greater the proportion of total fruit and vegetable supplies bought at auction. The group which traveled less than 25 miles to the most distant auction, however, bought about 55 per cent of their total fruit and vegetable supplies at country auctions, or a larger proportion than any except the group that traveled 200 miles or more. Buyers located within a mile of the nearest auction, which meant in nearly all cases that the buyer's place of business was at the same shipping point and usually very close to the auction, obtained about 59 per cent of their total fruit and vegetable purchases at auction.

SIZE OF BUYER'S BUSINESS

The relation of size of business to proportion of total fruit and vegetable purchases at auction was not entirely consistent. As the size of the business increased from less than $25,000 up to $150,000, the proportion of total purchases at auction increased from about 62 per cent to 72 per cent. For buyers whose total fruit and vegetable purchases exceeded $150,000, however, the proportion bought at auction declined to slightly more than 50 per cent.

PLACE OF PURCHASE

Only buyers who actually bought produce at some auction were included in this survey. Total fruit and vegetable purchases at all markets by those 114 buyers amounted to $11,618,118. Of this total, about 58 per cent was estimated to have been bought at country auctions, about 33 per cent at other small local markets, 9 per cent at the farm, and less than one per cent at city markets.

Of the total fruits and vegetables purchased by these 114 buyers in 1936, not more than 60 per cent could have been bought at auction within a reasonable distance of the buyer's place of business. Of the portion which could have been bought at auction within a reasonable distance, about 85 per cent was actually so purchased. Approximately 11 per cent was bought at small local markets other than country auctions, about 4 per cent at the farm, and only about one-tenth of one per cent at city markets. The proportion bought by northern buyers at small local markets other than auctions, at the farm, and at city markets was more than twice as large as the proportion purchased by southern buyers at these places.

COMMODITIES PURCHASED AT AUCTIONS

The 114 buyers reported total fruit and vegetable purchases at country auctions of nearly 7 million dollars in 1936. A little less than $6,200,000[13] of this total volume was estimated to have been bought at country auctions in southern States, and nearly $600,000 at auctions in northern States (table 27). Strawberries made up nearly 64 per cent, cantaloupes about 10 per cent, cucumbers about 9 per cent, and string beans about 7 per cent of the total value of all commodities purchased at auction by these buyers. No other commodity represented more than 3 per cent of the total. Cantaloupes were much more important in the southern than in the northern States; cucumbers and string beans were more important in northern

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[13] Since only about six million dollars worth of fruits and vegetables were sold by all southern auctions in 1936, it seems clear that the 114 buyers overestimated their auction purchases. Since 87 of these 114 auction buyers were local country dealers, and from 600 to 700 other buyers bought through these local buyers, however, it seems logical that a small number of buyers could account for a large share of the southern auctions' business.

States than in Southern States. These three commodities, together with strawberries, made up nearly 90 per cent of the gross purchases of all fruits and vegetables bought at country auctions by these 114 buyers.

PURCHASES BY EACH TYPE OF BUYER

Data obtained from the 64 auctions indicate that of the total sales at all auctions (totaling about 8.6 million packages of fruits and vegetables), about 40 per cent was to local country dealers, about 13 per cent to country dealers from other shipping points, 29 per cent to merchant truckers, 14 per cent to city wholesalers, jobbers, or their representatives, 3 per cent to buyers for canneries, juice plants, or wineries, and about one per cent to all other types of buyers (table 28).

TABLE 27. Relative Importance of Twenty-Two Leading Commodities Purchased at Country Auctions by 114 Buyers, 10 Eastern Seaboard States, 1936*

Commodity	Total fruit and vegetable purchases at auction			Proportion of total fruit and vegetable purchases made at auction		
	4 northern States	6 southern States	Total	4 northern States	6 southern States	Total
	Dollars	*Dollars*	*Dollars*	*Per cent*	*Per cent*	*Per cent*
Strawberries	119,000	4,183,637	4,302,637	20.1	67.7	63.5
Cantaloupes	5,600	652,199	657,799	0.9	10.5	9.7
Cucumbers	76,665	511,924	588,589	12.9	8.3	8.7
String beans	55,595	399,665	455,260	9.4	6.5	6.7
Tomatoes	31,257	175,250	206,507	5.3	2.8	3.0
Lima beans	31,325	133,010	164,335	5.3	2.2	2.4
Cauliflower	86,800	....	86,800	14.6	....	1.3
Sweet potatoes	47,100	....	47,100	7.9	....	0.7
Green peppers	26,600	16,670	43,270	4.5	0.3	0.6
Dewberries	....	33,000	33,000	....	0.5	0.5
Raspberries	25,175	....	25,175	4.2	....	0.4
Green peas	3,290	21,220	24,510	0.6	0.4	0.4
Blackberries	13,217	8,512	21,729	2.2	0.1	0.3
Sweet corn	2,716	18,360	21,076	0.5	0.3	0.3
Peaches	18,520	165	18,685	3.1	†	0.3
Dry onions	14,400	....	14,400	2.4	....	0.2
Apples	10,800	272	11,072	1.8	†	0.2
Irish potatoes	5,665	5,060	10,725	1.0	0.1	0.2
Broccoli	495	7,800	8,295	0.1	0.1	0.1
Eggplant	2,000	6,000	8,000	0.3	0.1	0.1
Brussels sprouts	5,300	....	5,300	0.9	....	0.1
Squash	425	3,950	4,375	0.1	0.1	0.1
Miscellaneous commodities‡	11,195	7,157	18,352	1.8	0.1	0.3
Total, all commodities	593,140	6,183,851	6,776,991	100.0	100.0	100.0

*All commodities which made up one-tenth of one per cent or more of total purchases at country auctions.

†Less than one-tenth of one per cent.

‡Includes cabbage, pears, huckleberries, cherries, lettuce, carrots, watermelons, beets, celery, spinach, romaine, dandelion greens, pumpkins, turnips, fava beans, okra, and miscellaneous fruits and vegetables.

Except for apples, peaches, and raspberries, country dealers handled a relatively large share of nearly all commodities. Merchant truckers bought relatively small quantities of strawberries, string beans, lima beans, green peas, and dewberries. They constituted the largest single outlet for raspberries, sweet potatoes, apples, peaches, blackberries, and Irish potatoes. Canneries, juice plants, or wineries bought only three commodities: tomatoes, strawberries, and dewberries.

TABLE 28. PROPORTION OF TOTAL VOLUME OF TWENTY LEADING COMMODITIES SOLD TO EACH TYPE OF BUYER,* 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS 10 EASTERN SEABOARD STATES, 1936

Commodity	Proportion of total volume sold to each type of buyer					
	Local country dealers	Country dealers from other shipping points	Merchant truckers	City wholesalers, jobbers, or their representatives	Buyers for canneries, juice plants, or wine factories	All other buyers†
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Tomatoes	40	4	30	5	20	1
Strawberries	38	32	15	14	1	‡
String beans	49	19	16	16	..	‡
Cucumbers	47	14	26	13	..	‡
Cantaloupes	44	24	20	12	..	‡
Cauliflower	30	..	31	39	..	‡
Green peppers	46	11	36	7	..	‡
Lima beans	53	13	17	17	..	‡
Sweet potatoes	22	..	74	3	..	1
Green corn	39	7	31	18	..	5
Apples	9	..	64	16	..	11
Peaches	15	..	64	19	..	2
Onions, dry	68	..	21	10	..	1
Watermelons	45	..	26	23	..	6
Green peas	52	14	17	16	..	1
Irish potatoes	29	‡	55	12	..	4
Eggplant	49	6	27	17	..	1
Dewberries	26	52	13	4	5	..
Raspberries	1	..	86	11	..	2
Blackberries	37	..	63	..	..	..
Miscellaneous commodities§	40	1	53	3	..	3
Total, all commodities	40	13	29	14	3	1

*Commodities which make up one per cent or more of either the total number of packages or the total gross value of all commodities sold at auction in 1936.

†Includes retailers, hotels, restaurants, hucksters, and consumers.

‡Less than one per cent.

§Includes all commodities sold at auction other than the leading twenty listed in the table.

METHODS OF SALE USED BY AUCTION BUYERS

In terms of dollar volume, about 36 per cent of all commodities purchased at auction by the 114 auction buyers was shipped to city commission merchants on consignment; about 30 per cent was sold to city wholesalers or jobbers on a delivered-at-market basis; about 15 per cent, to city wholesalers on order (f. o. b. country points); 6 per cent, to other country dealers at auction or other country points; 5 per cent, to merchant truckers at auction or other country points; 5 per cent, to city wholesalers on joint-account; 2 per cent, to canneries or juice plants; 1 per cent was delivered to retailers, hucksters, hotels, and restaurants; and less than 1 per cent was sold directly to consumers (table 35, appendix).

There was much variation between commodities as to method of sale. Approximately half or more of the onions, sweet potatoes, blackberries, dewberries, watermelons, green peppers, and green corn were shipped to city commission merchants on consignment. On the other hand, about two-thirds of the peaches and raspberries, and approximately one-half of the watermelons, cauliflower, and blackberries were sold to city wholesalers or jobbers f. o. b. the market. Three-fourths of the eggplant and one-half of the cucumbers were sold to city wholesalers on order (f. o. b. country points).

PLACES OF SALE USED BY AUCTION BUYERS

Approximately 25 per cent of the total dollar volume of all commodities sold by these 114 auction buyers went to New York City; about 18 per cent to upstate New York markets; 17 per cent to other New England markets; 15 per cent to southern markets; 9 per cent to Boston; 7 per cent to Pennsylvania cities other than Philadelphia; 4 per cent to Philadelphia; another 4 per cent to western markets; and one per cent to New Jersey markets.

New York City was the outstanding market for eggplant, raspberries, apples, dewberries, peaches, and blackberries, but it should be noted that the distribution of nearly all of the twenty leading commodities was over a relatively wide area.

OPINIONS OF BUYERS AS TO EFFECTS OF AUCTIONS

Changes in areas of distribution

The 114 auction buyers were asked to express an opinion as to whether country auctions had had any effect on changes in areas of distribution in recent years. Of the 97 buyers who replied affirmatively, about 82 per cent were of the opinion that auctions brought in more distant buyers which automatically widened the distribution of fruits and vegetables from the area.

Grading and packaging

In answer to the question, "Have country produce auctions had any effect on the grading of any commodities sold through them?", 81 of the 114 buyers (about 71 per cent) answered "yes"; thirty (about 26 per cent) answered "no"; and three gave no answer. Of the 81 buyers who answered "yes", all but two thought auctions had helped grading.

When asked the question, "Have country auctions been responsible for bring about any changes in packaging of any commodities sold through them?", about 30 per cent of the 114 buyers replied in the affirmative; but about 65 per cent answered negatively. Of the 34 growers who replied affirmatively, 14 thought auctions had caused more standardized packaging, and 9 thought auctions were responsible for more uniform packaging.

New buyers

In answer to the question, "Have country auctions attracted you to any producing areas where you had not bought in appreciable quantities before?", nearly 60 per cent of the 114 buyers answered "yes", and about 40 per cent answered "no".

Means of transportation

Of the 114 buyers, 88 were of the opinion that auctions caused more produce to move to market by motor truck than would otherwise have been the case, because auctions made it easier for merchant truckers to get loads. Most of the auction managers, owners, and grower-patrons also thought auctions helped movement by motor truck.

Prices paid

In answer to the question, "What effect have country auctions had on prices which you were required to pay to growers for commodities?", 86 of the 114 buyers (about 75 per cent) were of the opinion that the auctions had increased prices they had to pay, and only one thought auctions had decreased prices. About 20 per cent thought auctions had no effect on the prices they had to pay.

APPENDIX

TABLE 29. LOCATION OF 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS WHICH OPERATED IN 10 EASTERN SEABOARD STATES DURING 1936

Location of auction
Massachusetts:
Boston Regional Market
Connecticut:
Manchester
New Haven City Market
New York:
Highland
Riverhead, L. I.
New Jersey:
Hightstown
Beverly
Swedesboro
Glassboro
Hammonton
Landisville
Vineland
Rosenhayn
Cedarville
Delaware:
Bridgeville
Seaford
Millsboro
Laurel
Selbyville
Delmar
Maryland (Eastern Shore Section):
Federaldsburg
Pittsville
Salisbury
Berlin
Fruitland
Allen
Princess Anne*
Pocomoke City
Marion Station
Virginia (Eastern Shore Section):
Oak Hall Station
Atlantic
Temperanceville
Hallwood
Nelsonia
Bloxom
Hopeton
Parksley
Onley
Melfa
Keller
Painter
Craddockville
Exmore*
Nassawadox
Machipongo
Bayview
North Carolina:
Goldsboro
Cameron
Vass
Mount Olive
Calypso
Faison
Warsaw
Turkey
Rose Hill
Wallace
Burgaw
Chadbourn
Tabor City
South Carolina:
Loris
Lake City
Florida:
Wauchula

*Two auctions operated at Princess Anne, Maryland; and two at Exmore, Virginia.

TABLE 30. APPROXIMATE NUMBER OF PACKAGES OF FRUITS AND VEGETABLES SOLD THROUGH COUNTRY AUCTIONS IN 10 EASTERN SEABOARD STATES, 1911–1936

(Data are in thousands of packages, 000 omitted)

Year	New York	New Jersey	Massachusetts	Connecticut	4 northern States	Delaware	Maryland	Virginia	North Carolina	South Carolina	Florida	6 southern States	Total 10 States
1911	...	....	..	...	....	....	10	...	....	...	...	10	10
1912	55	....	..	...	55	....	13	8	....	...	...	21	76
1913	100	....	..	...	100	....	18	14	....	...	...	32	132
1914	140	....	..	...	140	....	25	15	....	...	...	40	180
1915	145	....	..	...	145	....	30	16	8	...	...	54	199
1916	160	....	..	...	160	....	35	17	12	...	...	64	224
1917	175	....	..	...	175	....	40	18	15	...	...	73	248
1918	165	....	..	...	165	....	45	34	18	...	...	97	262
1919	190	....	..	...	190	....	50	43	20	...	...	113	303
1920	200	....	..	...	200	55	120	53	60	...	...	288	488
1921	240	....	..	...	240	60	160	63	95	...	...	378	618
1922	268	....	..	...	268	65	205	73	205	...	...	548	816
1923	293	....	..	...	293	70	215	80	295	...	...	660	953
1924	242	....	..	...	242	110	240	92	310	...	...	752	994
1925	373	....	..	...	373	185	300	104	382	...	...	971	1,344
1926	458	....	..	...	458	210	340	120	470	8	...	1,148	1,606
1927	245	....	..	...	245	235	345	137	525	12	...	1,254	1,499
1928	332	161	..	...	493	300	371	149	570	14	...	1,404	1,897
1929	179	290	..	...	469	335	434	222	640	16	...	1,647	2,116
1930	53	641	..	...	694	370	488	239	673	18	...	1,788	2,482
1931	203	1,197	..	...	1,400	510	545	250	875	20	...	2,200	3,600
1932	273	1,444	..	8	1,725	590	586	281	1,016	47	...	2,520	4,245
1933	279	2,139	..	30	2,448	720	639	351	1,241	89	...	3,040	5,488
1934	542	2,461	..	66	3,069	870	691	392	1,402	102	90	3,547	6,616
1935	641	2,980	25	100	3,746	1,041	874	472	1,495	153	185	4,220	7,966
1936	861	3,125	51	144	4,181	1,158	879	498	1,300	198	395	4,428	8,609

TABLE 31. SOURCES OF GROSS INCOME, 64 COUNTRY FRUIT AND VEGETABLE AUCTIONS, 10 EASTERN SEABOARD STATES, 1936

Item	Proportion of gross income									
	Massachusetts, Connecticut, and New York combined	New Jersey	4 northern States	Delaware	Maryland	Virginia	North Carolina	South Carolina and Florida combined	6 southern States	Total 10 States
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Auction fees paid by growers	98.9	94.8	96.1	37.4	35.7	31.4	68.4	61.6	49.7	66.2
Auction fees paid by buyers	....	4.4	3.1	....	....	49.1	6.0	9.5	10.4	7.8
Brokerage fees paid by outside buyers	....	....	....	62.3	64.3	19.5	25.6	26.4	39.6	25.5
Other income	1.1	0.8	0.8	0.3	....	....	....	2.5	0.3	0.5
Gross income	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Item	Proportion of total expense									
	Massachusetts, Connecticut, and New York combined	New Jersey	4 northern States	Delaware	Maryland	Virginia	North Carolina	South Carolina and Florida combined	6 southern States	Total 10 States
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Personnel:										
Auctioneer	29.3	14.6	18.4	43.8	44.8	28.2	26.4	18.1	28.9	22.7
Manager	11.7	16.1	14.9	....	7.5	8.3	5.3	3.7	5.5	11.1
Inspectors	....	6.4	4.8	....	....	....	36.0	8.9	20.7	11.1
Auction clerk	9.2	7.1	7.6	16.8	22.2	12.3	4.1	12.9	9.4	8.3
Office clerks	9.1	11.0	10.5	5.6	3.4	8.9	1.8	1.7	3.1	7.6
Other employees	6.6	12.2	10.7	4.9	4.9	27.0	5.4	12.4	9.2	10.2
Employees' liability insurance	....	0.9	0.7	....	....	*	....	....	*	0.4
Total	65.9	68.3	67.6	71.1	82.8	84.7	79.0	57.7	76.8	71.4
Property:										
Interest on investment @ 5 per cent	2.4	5.3	4.6	8.8	0.9	0.6	0.4	21.4	4.0	4.3
Repairs and construction	5.4	4.2	4.6	1.8	5.1	1.2	2.0	0.2	2.0	3.6
Depreciation on buildings	2.8	2.0	2.2	8.5	1.5	1.2	1.2	10.9	3.1	2.5
Rent	6.4	0.2	1.8	2.7	1.5	2.5	2.2	....	1.9	1.8
Insurance	0.6	0.9	0.8	0.2	....	....	0.1	7.3	1.0	0.9
Taxes	0.6	0.9	0.8	1.1	0.4	0.3	....	....	0.1	0.5
Depreciation and purchase of equipment	0.4	0.7	0.6	....	....	....	0.1	....	*	0.4
Total	18.6	14.2	15.4	23.1	9.4	5.8	6.0	39.8	12.1	14.0
Supplies and services:										
Office supplies	3.5	4.8	4.6	0.9	0.8	0.9	0.4	0.2	0.5	2.9
Bank service	....	....	....	....	....	....	6.4	0.1	3.5	1.4
Auction supplies	0.6	0.1	0.2	....	0.4	0.9	4.5	1.0	2.7	1.2
Telephone and telegraph	1.8	1.5	1.6	2.0	1.1	0.6	0.6	0.4	0.7	1.2
Light and heat	0.4	0.6	0.5	....	3.0	....	0.7	0.2	0.8	0.7
Other	....	0.3	0.2	....	....	....	0.4	....	0.2	0.2
Total	6.3	7.3	7.1	2.9	5.3	2.4	13.0	1.9	8.4	7.6
Miscellaneous expense:										
Miscellaneous operating expense	2.0	5.5	4.6	2.7	2.3	5.6	1.9	0.6	2.4	3.7
Traveling expense	3.6	1.9	2.3	....	....	1.2	0.1	....	0.2	1.5
Advertising and publicity	1.0	1.0	1.0	....	....	....	....	....	....	0.6
Bad debts	0.9	0.6	0.7	....	....	....	....	....	....	0.4
Interest on borrowed money	0.3	0.6	0.5	....	....	....	....	....	....	0.3
Miscellaneous office expense	0.4	0.3	0.3	0.2	0.2	0.3	....	....	0.1	0.2
Other	1.0	0.3	0.5	....	....	....	....	....	....	0.3
Total	9.2	10.2	9.9	2.9	2.5	7.1	2.0	0.6	2.7	7.0
Total expense	$3385	$5351	$4649	$446	$531	$326	$1786	$1976	$860	$1689

*Less than one-tenth of one per cent.

TABLE 33. WHY GROWERS USED AUCTIONS, AS REPORTED BY 375 GROWERS, 10 EASTERN SEABOARD STATES, 1936

Reason*	Proportion of growers reporting each reason in†		
	4 northern States	6 southern States	Total 10 States
	Per cent	*Per cent*	*Per cent*
Higher net returns than from other methods of sale available	56	59	58
Only practical or reasonable method of sale available	..	24	18
Less risk in selling (more sure of getting money)	14	14	14
See their own produce sold and known what they get when they sell	14	11	12
Receive payment more promptly	7	9	9
Good way to dispose of "leftovers", or lots hard to sell by other methods of sale	10	7	8
Good way for small growers to sell who do not have enough to bother shipping	2	9	7
More convenient method of sale	7	4	5
Like the buyers who patronize auction	2	6	5
Saves time	17	..	4
More dependable method of sale (more certain that produce can be sold when it is harvested)	11	1	4
Can determine sooner when prices do not warrant harvesting any more of crop	..	3	2
Good way to dispose of small loads or mixed loads of produce	7	‡	2
Selling together at auction is a good way to foster cooperation among growers	8	‡	2
Establishes or holds up prices in producing area, and thus helps eliminate possibility of truckers driving down prices at farm	1	1	1
Less expensive than other methods of sale	4	‡	1
Local buyers that have always sold at auction now buy	1	1	1
Sold a little at auction to try it out	..	2	1

*The reasons listed here were arrived at by grouping and condensing the reasons actually stated by growers, according to the essential meaning or point of their statements.

†Percentages do not add to 100, because most growers mentioned more than one reason.

‡Less than one per cent.

TABLE 34. RANGE IN TOTAL VOLUME OF FRUIT AND VEGETABLE PURCHASES FROM ALL SOURCES, 114 BUYERS, 10 EASTERN SEABOARD STATES, 1936

Range in dollar volume of purchases	Buyers reporting		
	Average purchases per buyer		Percentage of total
Dollars	*Dollars*	*Number*	*Per cent*
Less than 25,000	15,716	15	13
25,000– 49,999	36,216	40	35
50,000– 74,999	62,377	16	14
75,000– 99,999	85,090	11	10
100,000–149,999	117,050	12	10
150,000–199,999	178,404	10	9
200,000 or more	481,108	10	9
Total or average	101,913	114	100

TABLE 35. METHOD OF SALE OF TWENTY LEADING COMMODITIES* BOUGHT AT COUNTRY AUCTIONS, AS REPORTED BY 114 BUYERS, 10 EASTERN SEABOARD STATES, 1936

Commodity	Proportion of total dollar volume sold by each method								
	City commission merchant on consignment	City wholesaler or jobber delivered (f.o.b. market)	City wholesaler on order f.o.b. country point	Other country dealers at auction or other country point	Merchant trucker at auction or other country point	To wholesaler on joint account	To cannery or juice plant	Delivered to retailers, hucksters, restaurants, and hotels	To consumers
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Tomatoes	16	23	1	2	23	..	34	1	†
Strawberries	38	33	9	6	5	6	2	1	..
String beans	36	22	23	7	8	4	..	†	..
Cucumbers	19	18	51	8	1	3	..	..	..
Cantaloupes	39	30	20	2	2	7	..	..	..
Cauliflower	28	45	9	..	6	..	..	12	..
Green peppers	48	31	1	12	8	..	..	..	..
Lima beans	30	25	28	9	6	2	..	..	..
Sweet potatoes	60	39	..	..	1	..	..	..	..
Green corn	44	35	8	1	5	..	..	5	2
Apples	17	33	2	..	7	..	..	25	16
Peaches	16	66	..	..	..	..	..	18	..
Onions	66	18	..	10	6	..	..	..	..
Watermelons	49	51	..	..	..	..	..	..	..
Green peas	32	21	27	7	12	1	..	..	..
Irish potatoes	23	33	20	2	2	..	..	15	5
Eggplant	13	6	76	..	5	..	..	..	..
Dewberries	54	29	2	..	15	..	..	..	..
Raspberries	39	59	..	..	..	..	..	2	..
Blackberries	54	44	..	..	†	..	..	2	..
Miscellaneous commodities‡	41	28	12	2	6	..	..	7	4
Total, all commodities	36	30	15	6	5	5	2	1	*

*Includes all commodities which made up one per cent or more of either the total number of packages or total gross value of all commodities sold at country auctions in 1936.

†Less than one per cent.

‡Includes all commodities other than the leading twenty listed in table.

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Bulletin 738 June 1940

Biology and Control of the Wheat Wireworm, *Agriotes Mancus* Say

W. A. Rawlins

WHEAT WIREWORMS

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BIOLOGY AND CONTROL OF THE WHEAT WIREWORM, *AGRIOTES MANCUS* SAY.[1]

W. A. Rawlins

One of the most important potato problems of upstate New York is the production of tubers free of the blemishes which render them of poor marketable quality. In recent years consumer demand for better and more uniform potato grades has stimulated grower interest in careful grading and packaging. Consumer discrimination against inadequately graded potatoes and subsequent loss of many choice markets have focused growers' attentions on potato defects, and their causes and measures of control.

These defects may be either of an external or an internal nature. Diseases and physiological changes cause various internal disorders that are not commonly noted on the surface. Defects that cause "rough" potatoes are the result of insects, diseases, unfavorable growing conditions, and the mechanics of handling from digger to grader.

A number of insects and allied forms feed on potatoes and produce various kinds of blemishes. In a previous publication (MacLeod and Rawlins, 1933) some of the more common injuries were illustrated and described in detail. Typical injuries were not always apparent in the field because one kind of defect was often masked by another. For instance, millipedes (*Julus* sp.) and scab-gnat maggots (*Sciara* sp. and *Pnxyia scabei*), commonly associated with potato scab, have been found to feed on and completely obliterate certain types of scab lesions. Their injuries are apparently of a secondary nature although there are reasons to believe that scab lesions are deepened or pitted by the invasion of millipedes and scab gnats. The scars, tunnels, and cavities caused by the feeding of wireworms and white grubs are chiefly primary; that is, without respect to other injuries. While each typical injury is distinct, the occurrence of many different types on the same tuber causes a confusing complex.

FIELD SURVEYS

A perspective of this tuber-defect problem may be obtained from field surveys made during the fall seasons of 1931 and 1932. With a number of departments cooperating in these studies and interested in particular phases of the problem, detailed and thorough investigations were made possible. Strictly from the entomological standpoint, it was essential to determine the factors concerned in the distribution of tuber defects and the causative organisms involved. The data obtained not only gave information on the extent of the defect problem but also were used as a basis for experimental field work.

The procedure of the survey was simple. Representative farms in the various potato-producing areas of the State were visited during harvest time and the tubers examined before being picked up in the field containers.

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[1] The material presented in this bulletin is a resume of a thesis offered to the faculty of the Graduate School of Cornell University, June 1936, in partial fulfillment of the requirements for the degree of doctor of philosophy.

Author's acknowledgments. The writer is most grateful to Dr. G. F. MacLeod, formerly at Cornell University, for his direction, advice, and encouragement during the course of this work. The keen interest and generous cooperation of potato growers and county agents are also appreciated.

At least twenty samples of five tubers each were selected at random and all the injuries were recorded as to severity and classification. In many instances where more than one soil type existed in the same field, data were collected for each type.

Generally one or more kinds of injury were found in each field, and frequently tubers were damaged with a variety of injuries. The summarized records express in table 1 the relative proportions of the most common defects, exclusive of mechanical injuries, present on the tubers examined. Inasmuch as a large number of fields in most of the upstate potato-producing sections were visited, the survey data accurately indicate the gravity of the defect problem at the beginning of the present investigations.

TABLE 1. PERCENTAGES OF POTATO-TUBER DEFECTS FROM SURVEYS AT HARVEST TIME IN UPSTATE NEW YORK

County	Number of records	Uninjured	Scabby	Rhizoctonia	Wireworms	Gnats	Millipeds
Summary for 1931							
Wyoming	23	46.5	4.5	28.1	19.1	7.7	4.2
Allegany	13	62.4	2.2	20.5	8.7	5.6	1.8
Steuben	26	53.5	3.6	17.1	16.4	7.6	14.6
Erie	12	52.3	....	13.5	19.9	8.4	6.1
Genesee	11	48.6	24.2	19.1	7.9	11.9	11.9
Monroe	18	27.7	17.4	16.8	40.9	15.3	18.2
Ontario	10	30.0	25.7	21.1	16.7	30.7	24.3
Onondaga	10	38.4	24.4	20.0	8.8	19.0	22.9
General average		45.7	11.3	17.5	18.7	11.9	12.2
Summary for 1932							
Clinton	21	39.9	28.5	6.6	17.8	7.0	.2
Franklin	10	47.7	9.8	20.6	17.1	3.2	.7
St. Lawrence	1	38.0	47.0	8.0	10.0	16.0	3.1
Wyoming	8	38.5	11.3	33.6	18.0	13.8	3.8
Steuben	11	41.1	3.3	26.2	33.2	8.6	10.4
Allegany	10	43.0	10.1	26.4	34.3	2.9	3.5
Erie	8	43.1	10.5	7.2	15.9	12.3	37.3
Genesee	13	36.7	19.7	27.2	18.6	11.5	12.6
Monroe	11	13.7	38.4	38.3	31.6	28.1	4.8
Ontario	10	34.2	21.7	25.9	23.0	21.6	13.4
Oswego	13	24.5	10.2	52.8	26.8	8.9	9.8
Onondaga	8	56.4	9.5	17.5	13.1	9.0	8.9
Oneida	9	58.9	10.1	17.1	11.0	10.3	11.9
General average		42.4	15.6	22.6	20.8	10.8	9.6

For the two years 1931 and 1932, referring again to table 1, more than one-half of all the tubers examined were damaged by insects and diseases. Of these injuries, excepting Rhizoctonia which produces a superficial flecking on the surface of the tuber and is therefore not a severe defect, wireworm injury was the most serious and widespread. In the respective two years 18.7 per cent and 20.8 per cent of the tubers were injured by wireworms. The injury was quite generally distributed throughout the State, although it was more important in some counties than in others. Even within neighborhoods the amount of wireworm injury varied considerably from farm to farm. It has been a common experience to find heavily infested fields with seriously injured potato crops near or bordering fields that were comparatively free of the pest.

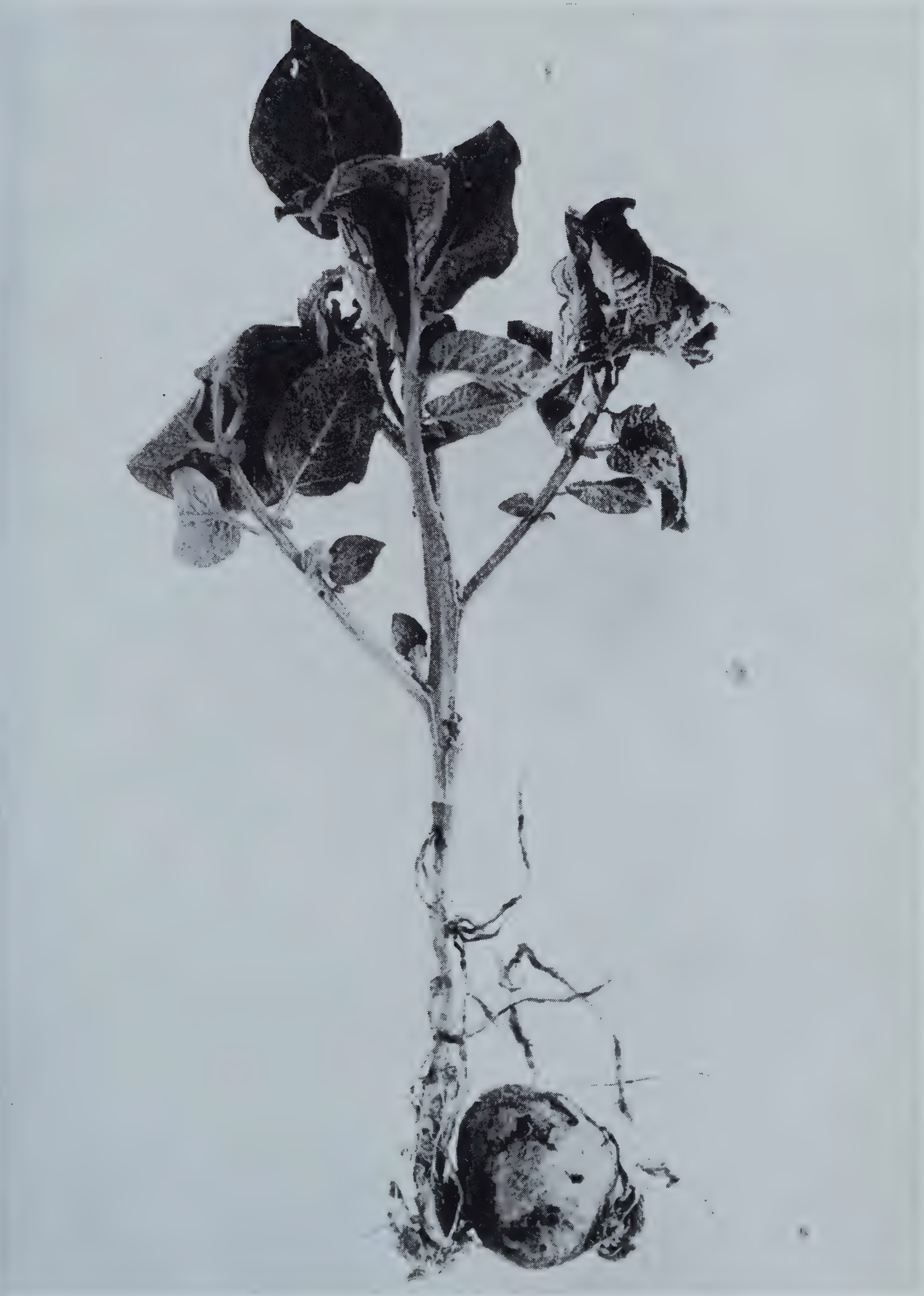


FIGURE 1. WIREWORM INJURY TO THE SEED TUBER
The tunnel entrances can be seen on the uncut surface

WIREWORM INJURY TO THE POTATO PLANT

The underground portions of the potato plant, seed piece, stems, stolons, and tubers are subject to wireworm attack. While injury is usually severe on all these parts, from the production standpoint damage to the tubers is the most noticeable and significant. The damage to tuber quality represents a much greater loss to the potato grower than does reduction in yields caused by wireworms feeding on seed piece and plant.

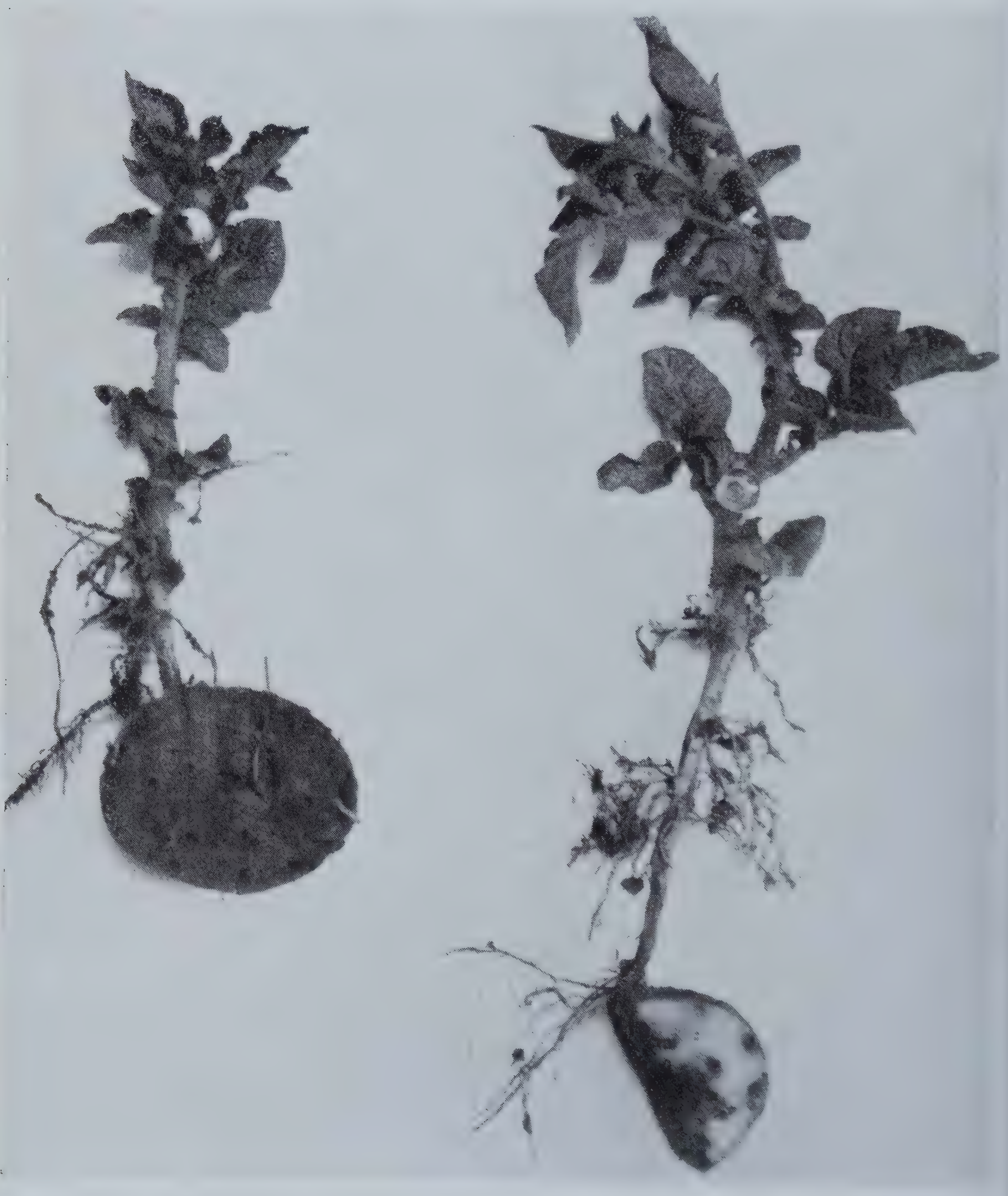


FIGURE 2. SEVERE INJURY TO THE POTATO SEED PIECE
Wireworms tunnel and honeycomb the interior

Seed-piece injury

Soon after planting, wireworms attracted by the seed pieces migrate to the potato hill where they immediately enter the mother tuber (figure 1). Within a short time seed pieces become interlaced with numerous tunnels which, in cases of prolonged feeding, leave the interior completely honeycombed (figure 2). The mother tuber remains attractive to the wire-

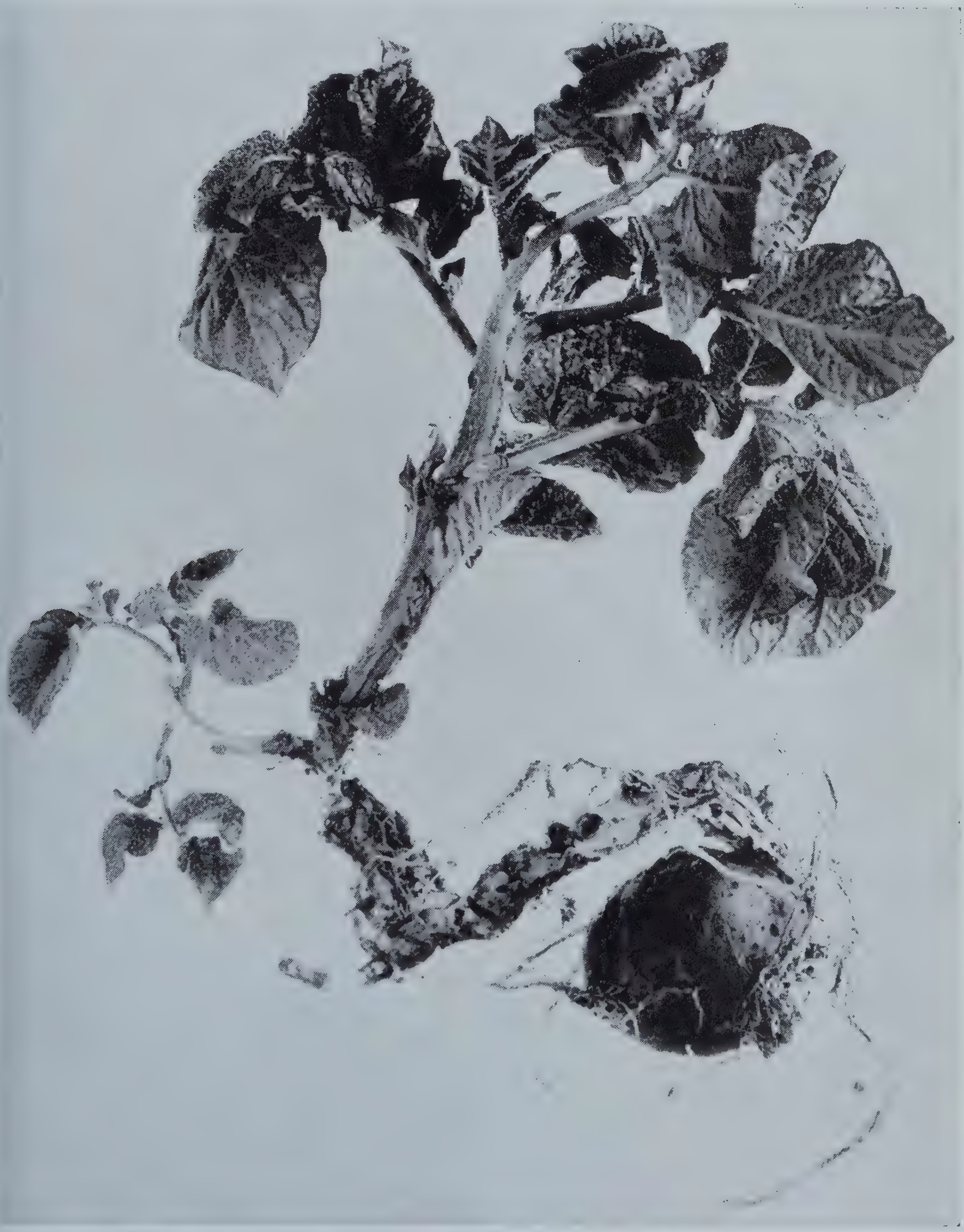


FIGURE 3. A GIRDLED STEM OF A POTATO PLANT, CAUSED BY THE FEEDING OF WIREWORMS

worms until the flesh completely disintegrates. Even then, some larvae remain in the rotted spongy interior, which at this time probably contains very little food material. Wireworm feeding on the seed piece not only reduces the tissue in which are stored nutrients for plant growth but also creates entrance points for bacteria and rot fungi, thus promoting rapid seed-piece decay.

Stem injury

The stem is subject to attack from the time the sprout forms until the stalk becomes hard and woody. Injury is usually slight except in cases of heavy wireworm infestations. Much of the stem-feeding occurs after the seed piece has decayed. The wireworms are then no longer attracted to the seed piece and turn their attentions to more favorable food. Although slight scarring of the stem does not seem to cause any depression in growth of the plant, severe injury results in the girdling or severing of the stem (figure 3). Girdled plants make a stunted abnormal growth similar to that resulting from injury by Rhizoctonia disease or by mechanical abrasion. Many small irregularly shaped tubers are produced immediately below the soil surface and frequently aerial tubers form in the leaf axials (figure 4). Such hills are worthless.

Tuber injury

Since the tubers are the crop, tuber injury is the most important of the damage to potatoes and the chief concern to the grower. Wireworms bore into the tubers leaving scars and holes on the surface. The tunnels extend to varying depths into the tuber flesh and may be so numerous that the tubers are completely honeycombed. There are several types of wireworm injury. Enlargement of the tunnels through continued tuber growth after injury or through invasion by soil organisms, causes variations from the typical and more familiar type of injury. For example, the tunnels in newly set and rapidly growing tubers become enlarged with tuber expansion and appear as funnel-shaped cavities characteristic of early wireworm injury (figure 5, A). Tunnels made when the potatoes have matured appear on the surface as small, round, clean-cut holes. This injury, designated as the late seasonal type (figure 5, B), is most typical of wireworm damage. A third variation of injury is locally referred to by growers as *pitting*. Characteristic of pitting are the dark, ragged, cankerous areas at the edges of the holes (figure 5, C), caused by the invasion of the tunnels by Rhizoctonia and other soil fungi. The term for this type of wireworm injury is loosely applied, inasmuch as any defect of a pitted nature, not necessarily caused by wireworms, is often called pitting. Certain other types of wireworm injury occur but are not common. Occasionally tubers are covered with numerous small "warts", or galls (figure 5, D), resembling to some extent enlarged lenticles. These "warts" may be formed, as a response to wounding, through abnormal tissue growth, with the result that the edges of the tunnels protrude slightly. Millipeds and scab-gnat larvae commonly enter wireworm holes and leave additional defects characteristic of their feeding. These various surface scars give injured tubers a rough, spotted appearance. However, it is the network of tunnels within the tuber which causes excessive and annoying waste when injured potatoes are prepared for the table. For this reason wireworm damage is one of the most important of the tuber defects.

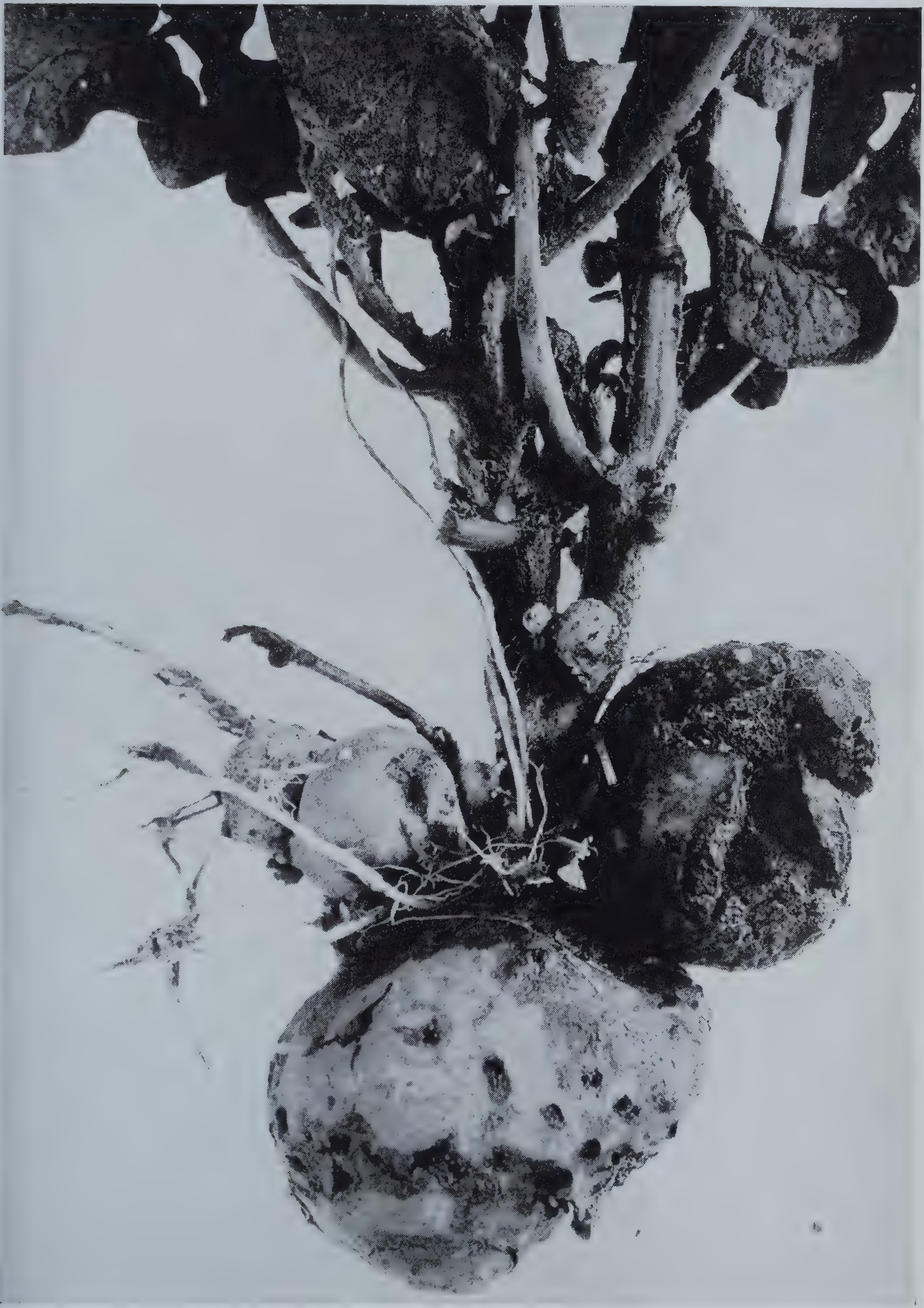


FIGURE 4. INJURY TO THE NEWLY FORMED TUBERS
These tubers will be small, misshapen, and worthless

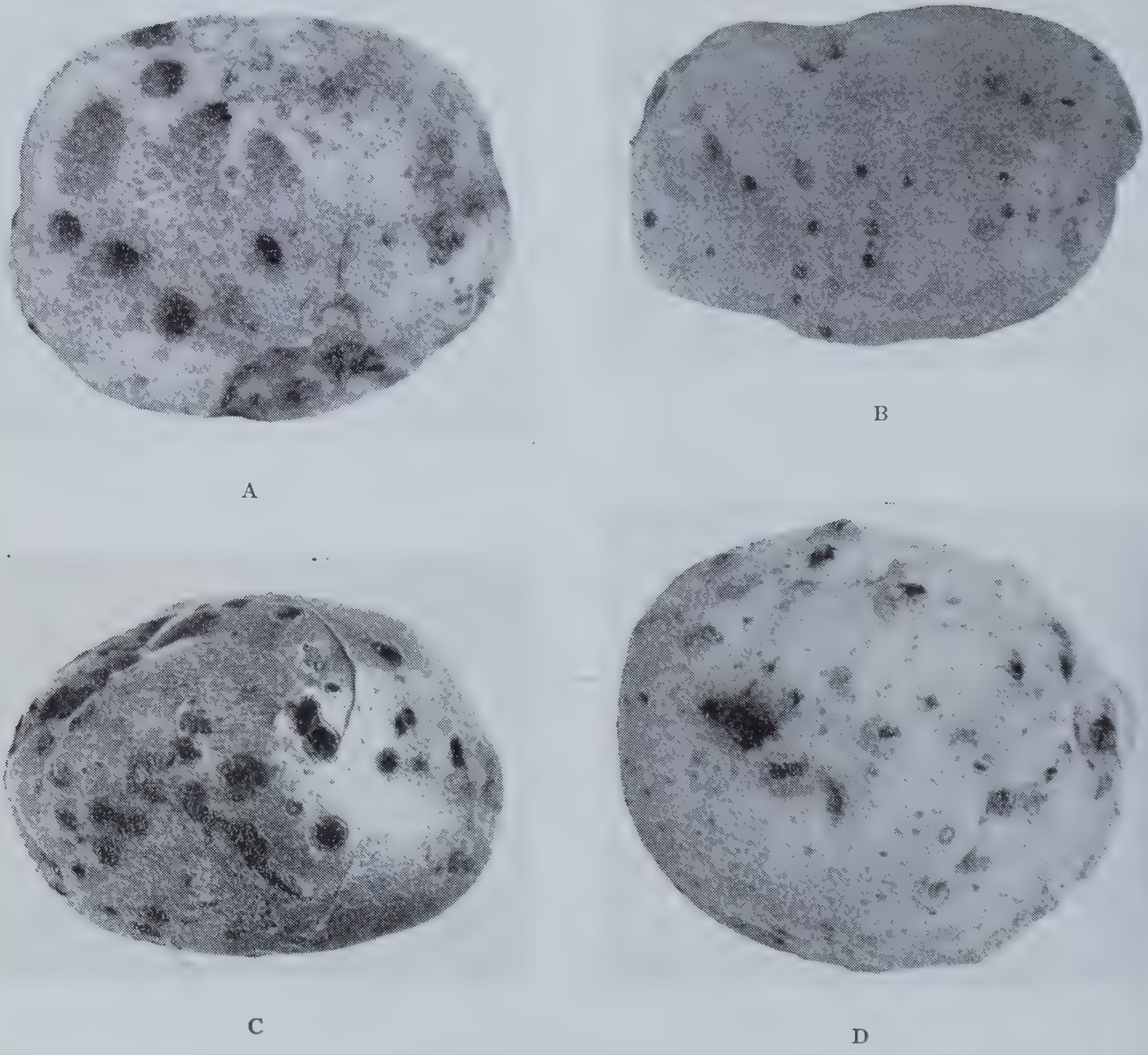


FIGURE 5. WIREWORM INJURY TO POTATO TUBERS

A. Early injury
B. Late injury
C. Pitting
D. "Pimples"

WIREWORMS IN POTATO FIELDS

Although 200 species of Elaterids have been recorded in New York State, only a few of these were commonly found in potato fields. The most abundant ones listed in order of their importance are the wheat wireworm (*Agriotes mancus* Say), the eastern field wireworm (*Limonius ectypus* Say), and the corn wireworm (*Melanotus* sp.). The abbreviated wireworm (*Cryptohypnus abbreviatus* Say), and the wireworm (*Aeolus mellillus* Say), occasionally were numerous but caused little or no damage to potatoes. In two instances while making wireworm surveys in potato fields, populations of abbreviated wireworms were as high as five larvae in each potato hill, but no tuber injury was evident. Generally these wireworms occur with populations of the more injurious species or in similar habitats.

Recent studies of the more common wireworms have quite clearly indicated that they differ considerably in life history and habits. This is important from the practical control standpoint because the most promising and most practical control measures are based upon certain peculiarities in the habits of these wireworms. Therefore, control measures used against one wireworm may not be effective against another species. Hence, it is important for potato growers to acquaint themselves with the distinguishing characters of these wireworms to properly diagnose their wireworm problems. Little difficulty should be encountered since the larvae of each species belong to a different and easily distinguishable group. For practical purposes, color of the wireworm and the shape of the ninth, or last conspicuous, abdominal segment will serve as identifying characters. The wireworm larva has ten abdominal segments, the last of which is small and lies below the larger ninth segment. In actuality the ninth segment, when viewed dorsally, appears to be the caudal segment. The three important wireworms are illustrated in plate I and in figure 6, which indicate comparative differences in larval characters referred to in the descriptions which follow.

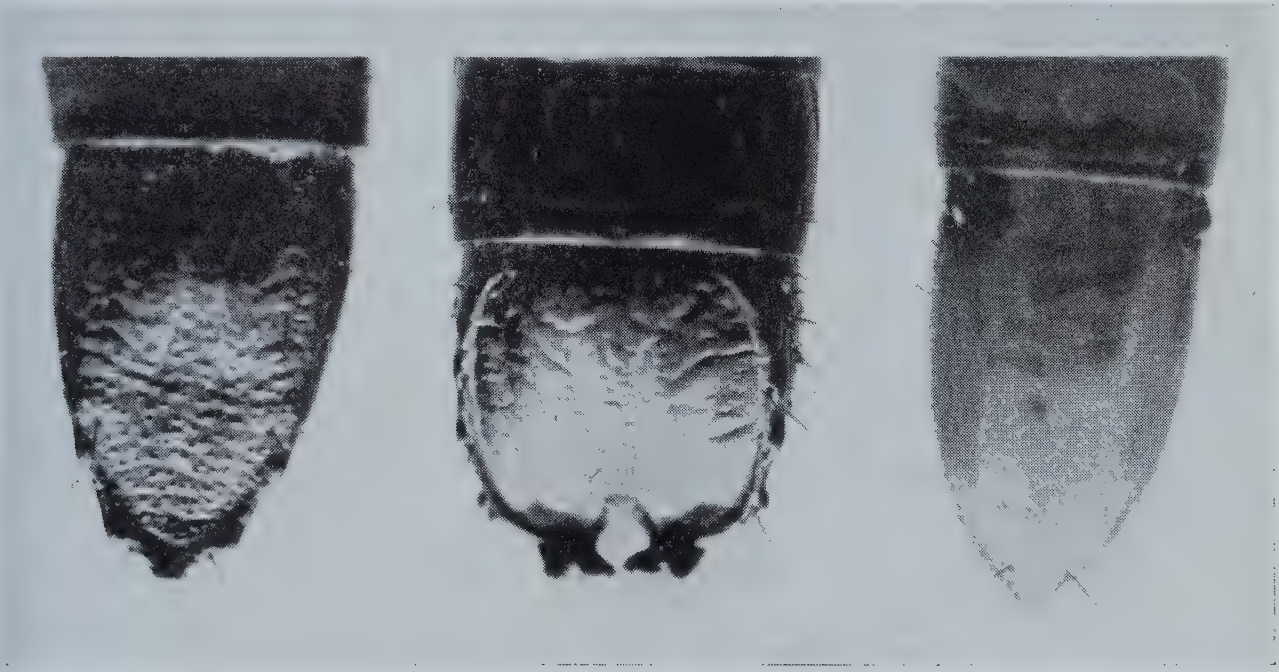


FIGURE 6. THE NINTH ABDOMINAL SEGMENTS OF THE THREE WIREWORMS MOST INJURIOUS TO POTATOES

Left to right: corn wireworm (*Melanotus* sp.); eastern field wireworm (*Limonius ectypus* Say); wheat wireworm (*Agriotes mancus* Say)

Differences in the beetles are not so outstanding as in the larval stages, although size and shape are distinctive characters for those well acquainted with wireworms. Since many species are numerous during the egg-laying and flight period, identification of beetles should be based on careful taxonomical examination. Some idea of the comparative sizes and shapes of the three important Elaterids may be obtained from figure 7.

The wheat wireworm (Agriotes mancus Say)

When full grown, the larva, or wireworm, is approximately three-fourths inch to one inch in length, slender, and a waxy light straw color. The caudal margins of each segment are somewhat darker than the remaining portion of the segment; thus, the larva appears ringed. The pointed ninth segment bears two black eyelike spots, or invaginations. This latter character is prominent and easily distinguishable on all of the wireworms belonging to the Agriotes group.

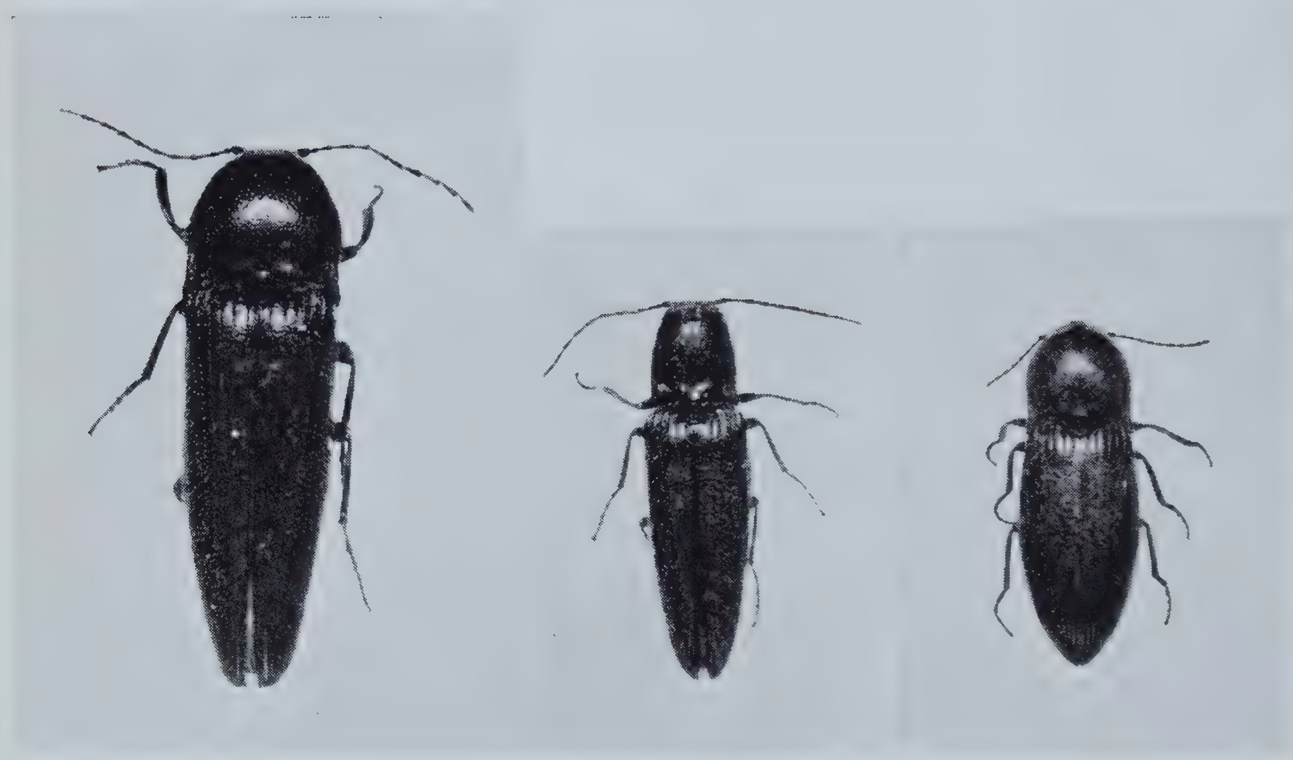


FIGURE 7. BEETLES OF THE THREE WIREWORMS MOST INJURIOUS TO POTATOES
Left to right: corn wireworm (*Melanotus* sp.), ×3; eastern field wireworm (*Limonius ectypus* Say), ×2½; wheat wireworm (*Agriotes mancus* Say), ×3

The beetle of the wheat wireworm is about one third of an inch in length, robust, and dark brown in color. The color varies somewhat from a light brown to almost black but is usually a dark shade. In the field, beetles are generally found near moisture under stones and clods of soil. They are rather inactive and are seldom noted moving about or in flight.

The eastern field wireworm (Limonius ectypus Say)

The eastern field wireworm, when mature, is also approximately an inch in length and is more robust than the wheat wireworm. It is darker in color, being a light tan. The ninth segment is distinctive. It is flattened dorsally and divided into two lobes, the points of which curve inward similarly to a pair of calipers. This larval character is found in a number of other species, and hence they may be confused with the eastern field wireworm. However, these other wireworms are rarely abundant and are not important as pests of potatoes.

The beetle of the eastern field wireworm is approximately seven-sixteenths of an inch in length and dark brown in color. Males are usually somewhat smaller than the females and are more slender. This species is more active than the wheat wireworm and is often noted in flight.

The corn wireworm (Melanotus sp.)

The corn wireworm is the largest of the three species. It is more than an inch in length and glossy red brown in color. The ninth segment is flattened dorsally and slightly scalloped along its lateral margins. The beetle is slightly more than one-half of an inch in length and glossy dark brown to black in color. It is wedge-shaped because the elytra narrow gradually from the base of the wide thorax. This is a distinctive character of most of the beetles belonging to the Melanotus group.

Distribution

These wireworms are widely distributed throughout the State in most potato-growing regions. Fortunately, few instances have been recorded of mixed infestations in which two or all three species were present in large numbers. Ordinarily, infestations are predominantly one species with an occasional wireworm of another kind. In a few cases heavy populations of both wheat and corn wireworms were found in the same fields. To date, survey records show that eastern field wireworms are seldom intermixed with other species. Of the three wireworms, the wheat wireworm is most abundant and widely distributed, probably accounting for most of the wireworm damage to potatoes in the State.

The regions and soils infested by the various species of wireworms differ greatly. The wheat wireworm is usually found in the heaviest soil types, the silt and clay loams of the dairy-farming regions where sod crops are an important part of the potato rotation. Corn wireworms are found most abundantly in orchard and meadow sods that have been left standing for many years. Occasionally light infestations occur in fields that are rotated frequently with cropping systems that include clover and timothy sod. Eastern field wireworms infest sandy soils almost exclusively. This interesting relationship has been noted in fields with zones of light and heavy soil types. Infestations were restricted to the sandy soils, with the result that injury to crops on these areas was severe, whereas on the heavier soil areas injury was nil.

Although all the above-mentioned wireworms feed on potatoes, the amount of damage varies with the species. This is strikingly brought out from examinations made in many potato fields in western New York. This survey was made in 1934 as a study of the relationship of infestation to injury. Potato hills in a number of fields were selected at random, the injured tubers counted, and the soil sifted for wireworm larvae. When more than one species was found in a hill, that hill was discarded and not considered in the data. In summarizing the data (table 2), the numbers of wireworms found were placed in four groups (1 to 2, 3 to 5, 6 to 9, and more than 10 wireworms to a hill). The data from knoll and low areas were recorded separately since wireworm populations and damage in these different sites make an interesting comparison. The amount of damage

TABLE 2. COMPARISONS OF NUMBERS OF WIREWORMS IN RELATION TO FREQUENCIES OF POTATO TUBER INJURIES

	Number of wireworms			
	1 to 2	3 to 5	6 to 9	10 or more
Eastern field wireworms:				
High areas	1:12	1:14	1:4	1:5
Low areas	1:6	1:5	1:4	1:4
Wheat wireworms:				
High areas	1:3	....	....	....
Low areas	1:2	2:3	3:4	6:7
Corn wireworms:				
High areas	1:5	....	....	....
Low areas	1:2	1:1	1:1	1:1

caused by any one population group is expressed as a ratio of injured to uninjured tubers. Thus the ratio 1 : 10 indicates that one tuber in ten was injured by wireworms. Judged on this basis, wheat wireworms and corn wireworms were most destructive because they injured a proportionately greater number of tubers than did the eastern field wireworms. For example, 3 to 5 wheat wireworms to a hill injured two of every three potatoes, whereas the same number of eastern field wireworms injured only one of every five tubers.

It is interesting too (table 3), that the knoll areas were only slightly infested with wheat and corn wireworms. Hill populations of more than 1 to 2 wireworms were not found in these areas. Eastern field wireworms infested nearly all parts of the field although low areas generally had higher populations than had knoll areas.

TABLE 3. COMPARATIVE NUMBERS OF FIVE SPECIES OF WIREWORMS IN HIGH AND LOW AREAS OF POTATO FIELDS

Species	Total numbers of wireworms (360 hills)	
	High areas	Low areas
Limonius ectypus Say	182	234
Agriotes mancus Say	25	258
Melanotus communis Gyll	14	112
Cryptohypnus abbreviatus Say	12	42
Aeolus mellillus Say	2	15

INVESTIGATIONS ON THE WHEAT WIREWORM

The yearly losses from wireworms aroused intense interest on the part of growers for an intensive and long-time research program. Therefore, investigations were initiated in 1930 with the establishment of a field laboratory near Gainesville in Wyoming County. During the following six years, laboratory and field studies were conducted on the wheat wireworm and the material presented in this bulletin is the summary of these researches.

HISTORY

The wheat wireworm originally inhabited the forests and grasslands before the advent of the intensive agriculture of today. It is probably one of the oldest pests of potatoes and was frequently mentioned by entomologists and agriculturists in their early writings. In these accounts they summarized the then meager and fragmentary knowledge of the biology and control of wireworms, and suggested further methods of control which had proved of value for some of their correspondents. Although much of this information was not based upon careful investigations, many of the observations have been confirmed through later experiments. Many of the early wireworm "remedies" have been handed down to the present day and are often mentioned as valuable adjuncts to the wireworm-control program. The use of salt, for instance, was highly regarded years ago for repelling or killing wireworms and is still suggested by many growers as beneficial. However, careful experiments have definitely shown that salt has no value against wireworms except in amounts toxic to growing crops.

The first extensive researches were undertaken by Comstock and Slingerland (1888, 1891), and their results were published in the first bulletins issued by the Cornell University Agricultural Experiment Station. After engaging in a large number of carefully executed experimental trials they regretfully reported that their experiments had "failed to discover a single satisfactory method of protecting seed, or of destroying immature wireworms in the soil."

Experimental work then lapsed for some years until resumed by Hyslop (1915–1916) who contributed to the knowledge of life history and control. More recently Hawkins (1936) conducted many and extensive studies on the wheat wireworm in Maine and summarized his results in a detailed bulletin from that Station. Wireworm work was again resumed in New York State with the inception of the present project in 1930, the results of which are similar to those published by Hawkins.

BIOLOGY OF THE WHEAT WIREWORM

EGG STAGE

The tiny pearly white eggs (figure 8, A) of the wheat wireworm are laid in crevices of the soil, or under stones and surface debris. They are nearly spherical in shape, unless distorted when squeezed between soil particles in the process of oviposition. The eggs are very small, 0.5 of a millimeter, or approximately 1/50 of an inch, in length, and 0.45 of a millimeter in width.

When the eggs are first laid they are covered with a coating of sticky material which cements soil particles to the egg coverings. In such cases it is practically impossible to distinguish eggs covered with soil from small soil particles. Hence, it is difficult to find the eggs in oviposition cages and in the field.

To overcome this difficulty it is necessary to wash soil containing the eggs through a 60-mesh sieve, which is fine enough to retain the eggs. A gentle stream of water is carefully applied to avoid forcing the eggs through the screen or causing injury. The eggs are then sorted from the debris and lifted out by a blunt dissecting needle or by a camel's hair brush.

A flotation method is useful, especially in field work where large soil samples are handled. The debris and eggs remaining after thorough washing of the samples are mixed with a strong solution of either common salt or magnesium sulfate. The eggs float on the surface of the saline solution and are then readily separated from soil particles, which settle rapidly to the bottom. The eggs should be washed free of the salt to avoid injury to the developing embryos.

After removal of the eggs from the water they may be dried by a short exposure to dry air. However, they are so extremely susceptible to desiccation that exposures of one-half hour to dry air or soil will cause the eggs to lose moisture and collapse. They are then no longer viable.

Determination of hatching is difficult when the eggs are mixed with soil. Because of their small size, magnification is necessary and the separation of newly hatched larvae from the soil mass is time-consuming. A satisfactory method of observing the eggs and at the same time protecting them from molds is to keep them under water. Eggs hatch normally under water and the young larvae remain alive from two to three days.

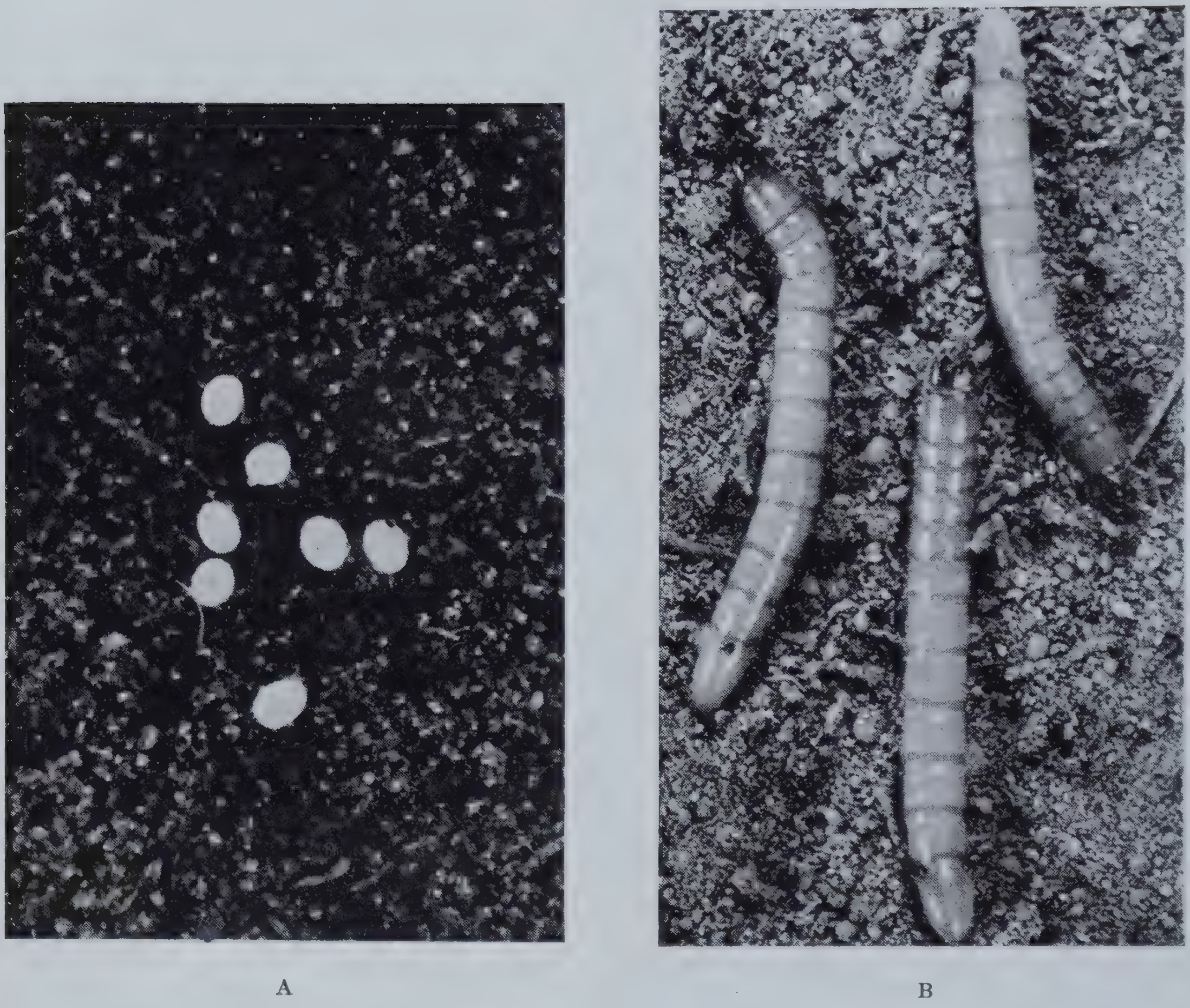


FIGURE 8. EGGS AND LARVAE OF WHEAT WIREWORM

A. The eggs are tiny and pearly white (×8)

B. The characteristic black eyelike spots can be seen on the ninth abdominal segment of the larva (×2½)

Under temperatures prevailing in the field laboratory, the eggs hatched after periods varying from 22 to 28 days. The average incubation period was approximately 25 days. For each batch of eggs laid during a 24-hour period, two to four days elapsed between the beginning of hatching and the end.

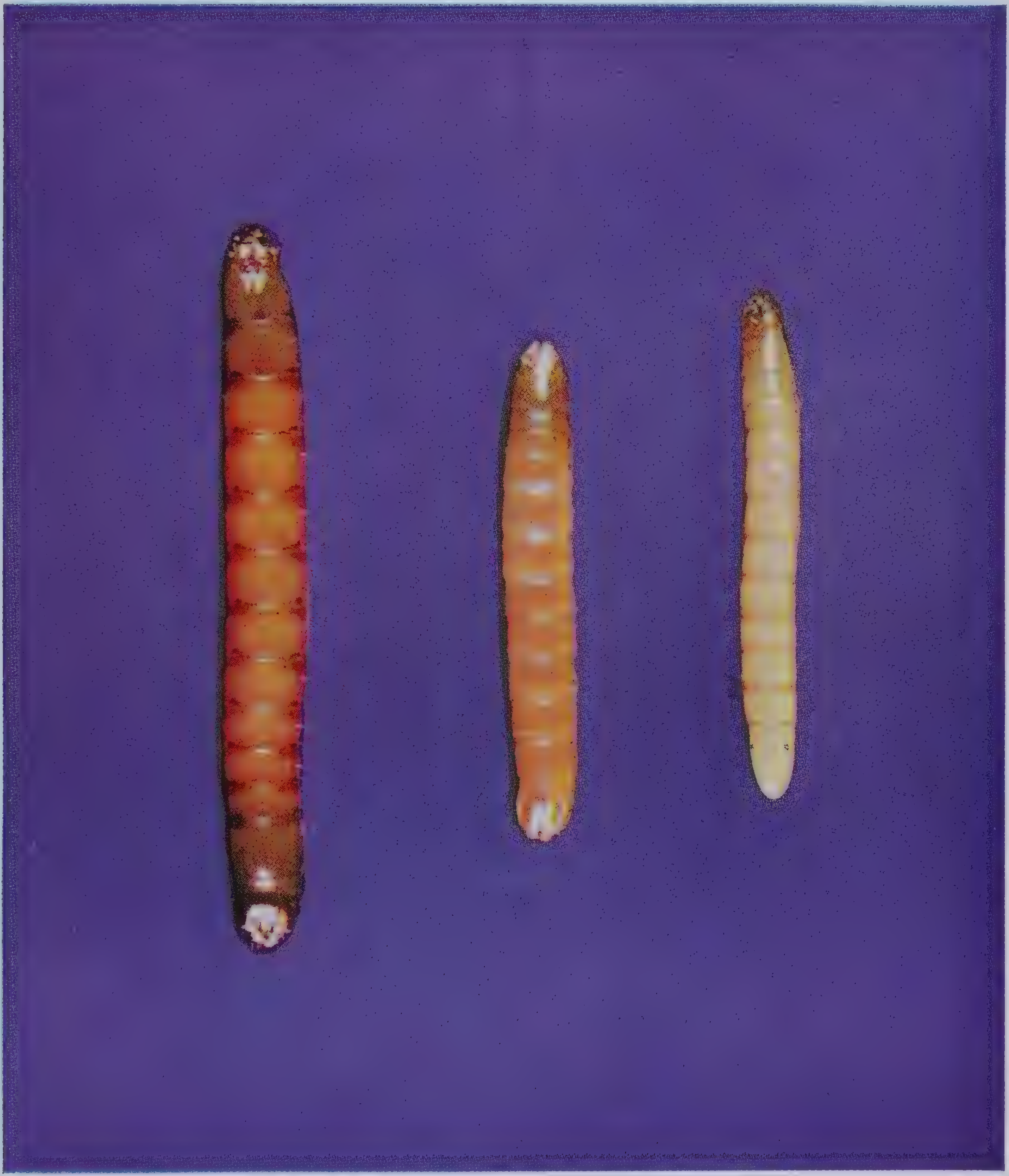
LARVAL STAGE

Wireworms in the first year

Young larvae upon hatching are milky white in color and exceedingly small, measuring 1.5 to 2 millimeters in length. They grow slowly during the first year, attaining a length of from 3.5 to 6 millimeters. This is a noticeable variation in size and occurred even in laboratory-reared populations of the same approximate age. Measurements of first-year wireworms taken from field samples were found to follow the usual distribution curve with an average at approximately 4.5 millimeters.

Wireworms in the second year

During the second year the wireworms grow more rapidly and are particularly injurious at this time. Molting in the field occurred chiefly during two periods, in the spring (May and June), and again in the fall



THE THREE WIREWORMS MOST INJURIOUS TO POTATOES

Left to right: corn wireworm (*Melanotus* sp.); eastern field wireworm (*Limonius ectypus* Say); wheat wireworm (*Agriotes mancus* Say)

(August and September). During the molting periods larvae cease feeding and become quiescent while the new cuticule is forming.

At the end of the second year, variations in larval size are still evident. This is shown from measurements taken on wireworm populations found in two fields on the same farm, one cropped to potatoes and the other in sod. Infestations in both cases started in sod the two years before, and only the second- and third-year wireworms were considered in the measurements. The wireworms found at harvest time in the potato field measured 9 to 20 millimeters in length (figure 9), a spread of 11 millimeters. Most of the larvae were in the larger intervals, 15 millimeters and above. Wireworms in the sod, exclusive of the current season's infestation, varied in size from 6 to 18 millimeters. The greater proportion of the population was between 8 and 13 millimeters. This bit of evidence indicates that some crops influence the growth of wheat wireworms and thus may influence the length of the life cycle. This presents an interesting problem that may be of significance in planning control measures.

Wireworms in the third year

Most of the larval growth, provided conditions are favorable, takes place during the second year. Previous to pupation in the third year, wireworms are 15 to 22 millimeters in length. However, size is not a true criterion of maturity, as judged by the onset of pupation. In both laboratory-reared and field populations only a portion of the third-year wireworms pupated. The remainder required a fourth year of growth before transformation. It is possible that a few individuals may require five years for full larval development.

Hibernation

During the winter months, wireworms hibernate at varying depths in the soil. Although there is a slight migration downward in the soil, many

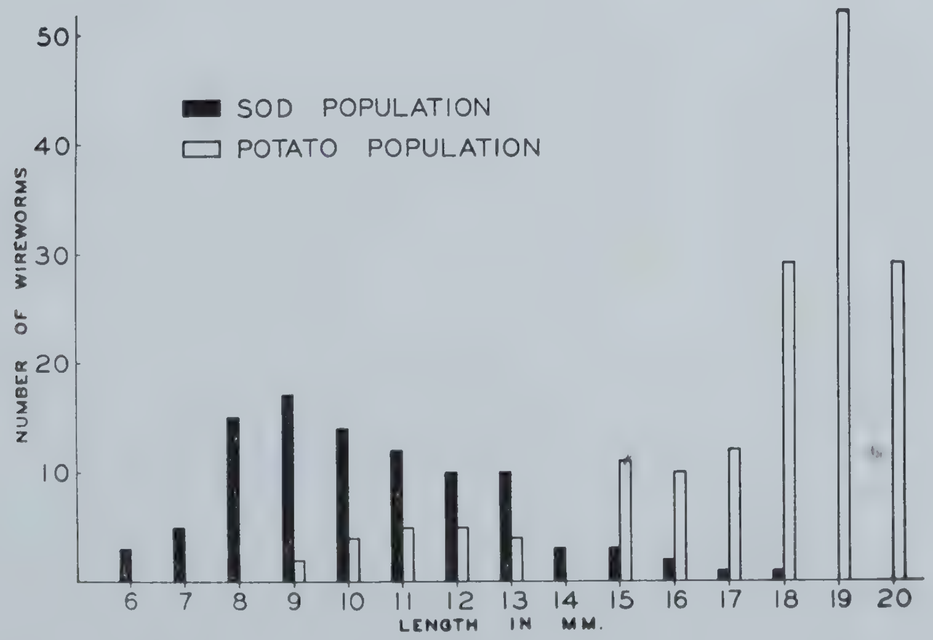


Figure 9. Size variations of second- and third-year wireworms from populations in fields planted to clover-timothy sod and to potatoes

of the wireworms remain within the frost zone. In many instances wireworms found in frozen soil revived and appeared normal. Many workers have reported that exposures to extreme cold temperatures will kill wireworms. However, such temperatures are seldom reached during the normal winter even in the frost zone. Early in the spring the wireworms move upwards to feed on available plant roots. When the topsoil is moist, wireworms are often found under stones and surface debris.

Food and food plants

Wireworms are indiscriminate feeders. Their food consists of the underground parts of living plants and, according to many authorities, it also includes humus and small soil-inhabiting animals. The list of food plants is almost an endless one. Injury is particularly severe to sprouting seeds, seedlings, transplants, roots, and tubers. Crops severely injured are usually designated *susceptible*, as distinguished from *immune* crops, which are able to withstand wireworm attacks without loss or damage.

The role of humus as food for wireworms is a controversial question. Some investigators believe that the decaying organic material of the soil is a predominant part of the wireworm diet. In fact the use of farmyard manure and green-manure crops has been suggested as a means of reducing injury, since it was believed that wireworms attack growing plants only in the absence of humus. However, wheat wireworms have caused severe damage to potatoes in soils well supplied with organic matter.

The food of the newly hatched wireworm is composed chiefly of the succulent underground parts of living plants, the roots, stems, and tubers. Although humus is abundant in soils infested by wheat wireworms it is not important in their diet. Newly hatched larvae fail to survive in these soils unless roots of growing plants are available for food. If these newly hatched larvae ingest particles of humus they are either unable to utilize this material as food or the humus does not contain enough food substance to support life.

The older second- and third-year larvae are considerably more resistant to starvation than are newly hatched wireworms. Individuals have remained alive in soil without growing plants for at least two years, but larval growth was apparently static during this time. However, a high mortality occurred during the first year of the starvation period and only a few of the original number remained alive when the experiment was discontinued.

PUPAL STAGE

A few days previous to pupation during the latter part of July and throughout the month of August the mature wireworms cease feeding and construct their pupal cells (figure 10, A). By rolling and twisting movements the larvae form small cavities large enough to accommodate the pupae. The larvae then become quiescent, and within a short time transform to white wax-like pupae which bear a close resemblance to the beetles in size and shape. From this apparently lifeless form the beetles emerge in approximately two weeks. Unless disturbed they do not venture from their pupal cells until the following spring.

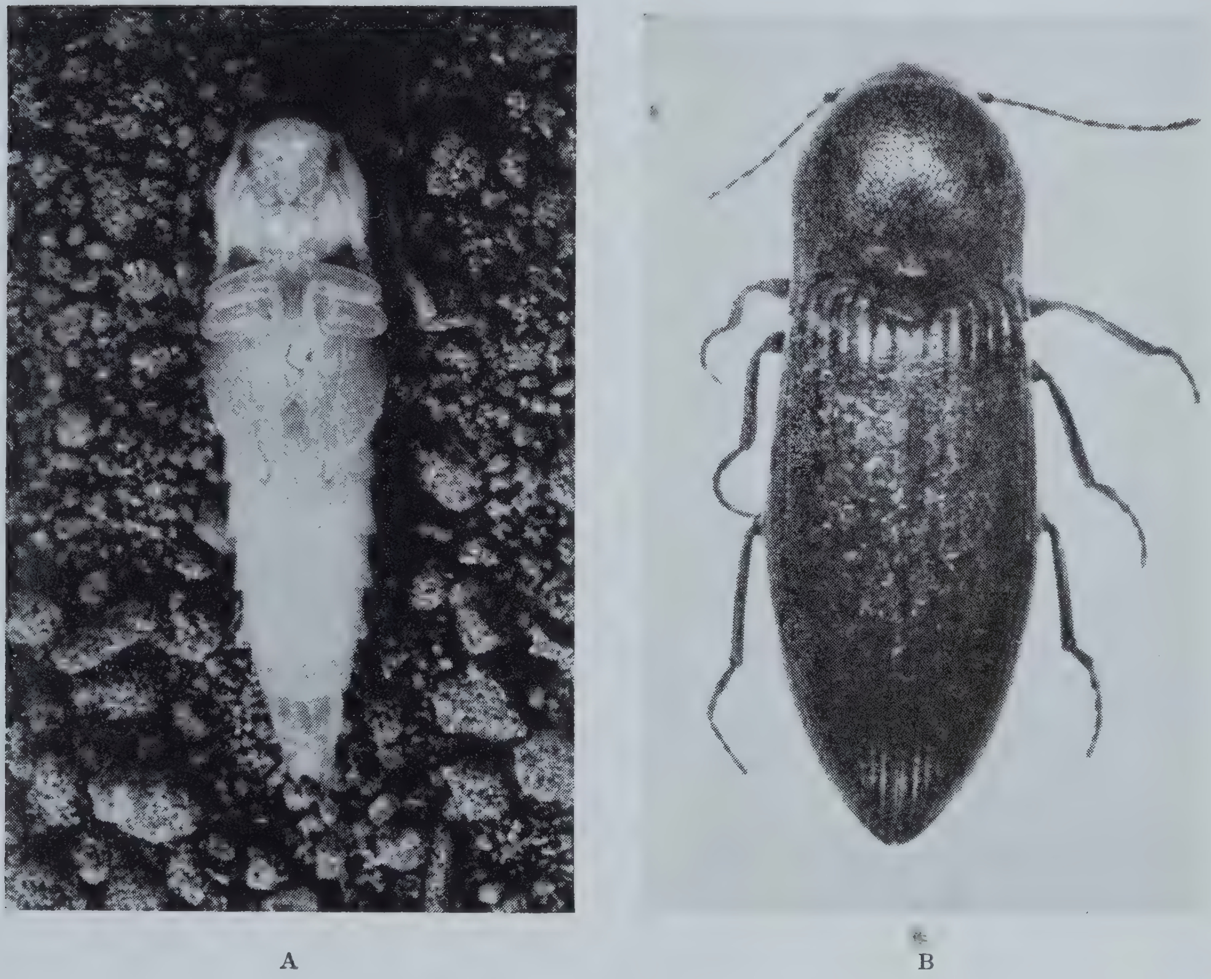


Figure 10. pupal and adult forms of the wheat wireworm
A. Pupa (×4)
B. The dark-brown adult, or click beetle (×6)

ADULT STAGE

The beetles, known as *click beetles*, or *skip jacks*, because of their ability of springing into the air when turned on their backs, leave the pupal cells as soon as the soil warms up in the spring and make their way to the surface during late April and May (figure 10, B). They are not ordinarily noticed in the field unless special efforts are made to collect them. Beetles emerging in cultivated fields hide under stones, soil clods, and other surface objects, where they collect in large numbers especially during the mating season. In sod and grasslands the beetles find shelter in the crowns of the plants and in crevices in the soil. The heavy cover of sod and grass offers so many hiding places for the beetles that they are difficult to find except by sweeping with an insect net.

Migration

Wheat-wireworm beetles are most active during warm days when the temperatures are above 85° F. They are not so active, however, as many other Elaterids. In cultivated fields an occasional individual may be seen during the daytime running from one place of concealment to another. Sometimes they are noticed perched on stones or clumps of soil. Spasmodically they make feeble attempts to take flight.

During warm days of May and June large numbers of the beetles may be conveniently collected from sod and weedy growth in infested fields.

A large proportion of these are males. Upon close examination they are found resting on the stems and foliage of the vegetation. When disturbed they immediately fall to the ground and disappear into the foliage cover. Observations have been made many times of beetles resting on foliage and flowers, but no evidence of feeding has been noted. In cages the beetles chew the cut edges of grass clippings and apparently ingest some of the pulpy material. They also feed voraciously on sugar syrup, molasses, and honey.

On a few occasions wheat-wireworm beetles were noted in flight. The evidence indicates, however, that they are not active fliers and probably migrate very little by flight. Beetles were seldom taken in sweepings on bushes and shrubs along woodlands and fence rows bordering infested fields. Other species of the genera Limonius, Ludius, and Melanotus are common on wild cherry, blackberry, and other shrubs. Beetles captured on tanglefoot traps were chiefly of these species. The traps were constructed of hardware cloth tacked to frames and mounted on posts four to five feet from the ground. Tanglefoot was liberally applied to the wire cloth to make a sticky surface. Beetles flying against the tanglefoot were captured and retained on the screens. The summarized catch records of table 4 indicate that wheat-wireworm beetles are not as active fliers as the other species.

Beetles are extremely susceptible to desiccation and succumb when exposed to long periods of dry air or soil. They are usually found in moist places close to the soil surface. For this reason fields covered with vegetation are more favorable to adult life than are cultivated fields. Many investigators have suggested that the beetles migrate to grasslands for oviposition. Observations by the writer have not intimated such a migration.

TABLE 4. TANGLEFOOT-TRAP RECORDS OF ELATERID BEETLES CAPTURED IN 1934 AND 1935

Number of trap	Crop in field in which trap was located	Numbers of *Agriotes mancus* beetles captured	Numbers of other species captured
1	Sod	0	2
2	Sod	0	14
3	Sod	5	65
4	Oats	3	7
5	Potatoes	0	45
6	Potatoes	0	11
Total		8	144

The attractiveness of moisture and places of concealment provided a means of collecting beetles in fields frequently tilled by harrow or cultivator. Baits similar to those suggested by Comstock and Slingerland (1891) were used. These baits consisted simply of a handful of grass or weeds placed on moist soil and covered with a shingle. During the night the beetles, attracted by the baits, congregated in the foliage and were collected the following day. This method of collecting beetles works very well for cultivated fields but is ineffective in sod and grasslands.

Beetles were present in large numbers on cultivated fields during the egg-laying period as long as moisture conditions were favorable. A thorough survey of two fields by the use of baits showed that beetles did not migrate from infested areas to those uninfested. As mentioned before, infestations of wheat wireworms are spotted. They occur chiefly in the low portions of the field. The collection data for the two fields show that the beetles do not migrate from the low areas of the fields to the knolls, which are relatively free of wireworms.

This is not surprising since beetles migrate chiefly by running over the soil surface. The distances traversed are therefore limited. This is brought out in an experiment designed to obtain further information on beetle migration. A large number of marked beetles were released on a cultivated field and allowed to disperse. Daily bait catches were examined for marked beetles during the period of beetle activity. More than half of the beetles released were again captured in the numerous baits surrounding the point of release. The longest recorded distance traveled by the beetles was about eleven yards.

Bait records taken in three fields during the years of 1934 and 1935 shed some light on beetle activity. The spring of 1934 was marked by a shortage of rainfall, whereas precipitation was more plentiful in 1935.

In 1934 the topsoil surface dried out quickly, especially after cultivation. When the soil had dried out, unfavorable conditions prevailed and the beetles disappeared. After the start of egg-laying in the laboratory (table 5) on June 10, only one beetle was captured in the traps. Dead beetles which had apparently succumbed from desiccation were found under stones and under the piles of dried grass thrown aside after use in the baits. This would explain the absence of beetles in the baits after June 5, at which time the topsoil was very dry.

TABLE 5. BAIT-TRAP RECORDS OF WHEAT-WIREWORM BEETLES IN A CULTIVATED FIELD, 1934

Date of baiting	Number of beetles	Observations
May 28	146	Soil moist; beetles under stones and lumps of soil
May 30	122	Same as above
June 2	176	Field harrowed; soil drying out
June 5	34	Soil very dry
June 10	...	Egg-laying began in laboratory
June 13	1	Potatoes planted; topsoil very dry
June 27	0	Plants above ground; weeded

In the spring of 1935 rains were frequent and the seasonal rainfall was normal. The soil surface did not dry out so thoroughly as in the previous year, even with a number of cultivations. Beetles were collected in traps throughout June after egg-laying had started (table 6). Dissection of female beetles at each collection indicated that they had laid nearly all of their eggs at that time. In this instance, at least, migration of beetles to grasslands for oviposition was not substantiated.

Oviposition

Eggs are deposited in the soil either singly or in groups. In laboratory cages, the females place their eggs in cracks and crevices of the soil and under surface objects. No attempts are made by the beetles to burrow

TABLE 6. BAIT-TRAP RECORDS OF WHEAT-WIREWORM BEETLES IN TWO CULTIVATED FIELDS, 1935

Date of baiting	Number of beetles	Observations
Field 1		
May 28	163	Soil moist
June 7	189	Soil drying out slightly; egg-laying started June 6 in laboratory
June 13	201	Same as above
June 14	701	Soil moist
June 30	21	Soil moist
July 5	8	Soil moist
Field 2		
May 29	16	Oats planted in this field; soil moist
June 4	94	Soil moist; egg-laying started June 6 in laboratory
June 11	24	Soil moist throughout the baiting period
June 22	12	
June 29	12	
July 1	6	

deeply into the soil as do some other Elaterids. The eggs are usually deposited in the upper one-half inch of soil.

The number of eggs laid by single female beetles varies considerably under laboratory conditions. For ten individuals, the maximum number laid was 176 and the minimum number was 48. The average number was 104.9. Considerable difficulty was experienced in obtaining data on egg-laying because most of the female beetles died before laying all of their eggs. Beetles collected early in the spring did not oviposit unless fed on sugar solutions. Food appeared to be necessary during the oviposition period. However, the food requirements for the beetles is incompletely known at the present writing.

SUMMARY

The story of the life history is graphically indicated in figure 11. Beetles of the wheat wireworm leave their pupal cells early in the spring and appear on the soil surface during a period from May to late July. Eggs hatch in approximately three weeks. The young wireworms grow very slowly the first year, barely measuring a quarter of an inch in length by fall. Growth is most rapid during the second year. Some of the wireworms reach maturity and pupate during the third year of the life cycle. The remaining larvae transform to pupae the following year. Pupation occurs in late July and August. The final transformation to the beetle stage two weeks after the start of pupation completes the life cycle. The interval of time between the appearance of generations is three to four years.

CONTROL MEASURES FOR THE WHEAT WIREWORM

The efforts of entomologists have been directed towards efficient and practical methods of wireworm control since the beginnings of applied entomology. In a comprehensive review, Thomas (1930) briefly summarized the present knowledge of wireworm control, as included in more than two hundred references contributed from all parts of the world. A survey of this mass of literature reveals a wide diversity of ideas and considerable conflicting opinion. This is not surprising since the practical success of any control measure depends upon a complexity of factors which differ with wireworm species, crops, climates, and agricultural practices.

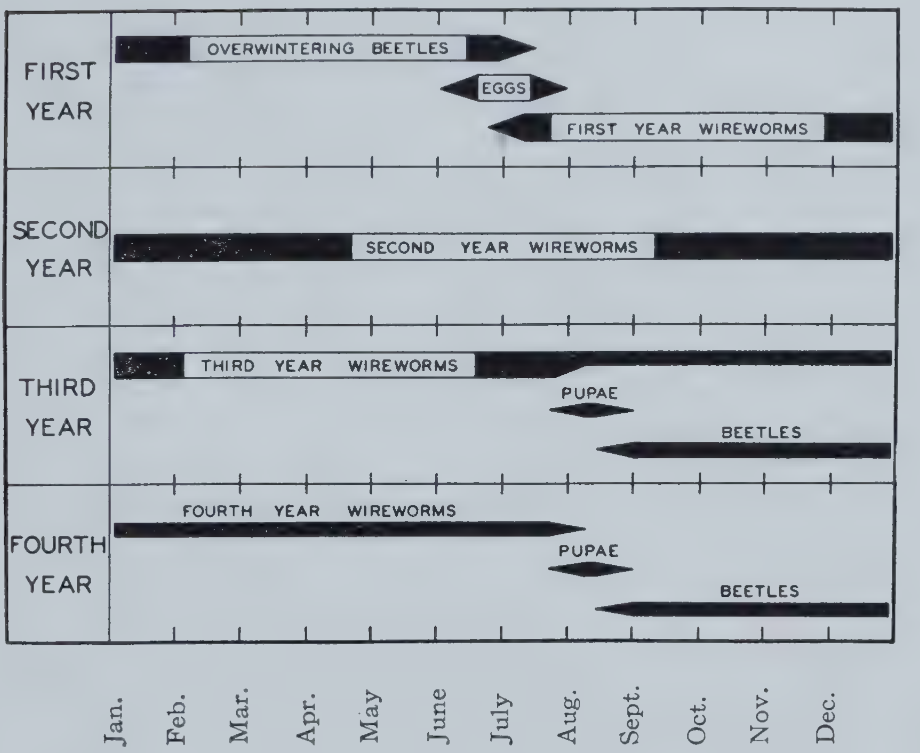


FIGURE 11. LIFE HISTORY OF THE WHEAT WIREWORM

Measures recommended and employed for the control of wireworms are as varied as they are numerous. Such methods employ the use of (a) soil fumigants and sterilizers, (b) seed protectants and repellents, (c) and cultural practices. Soil fumigants and sterilizers such as cyanides, chloropicrin, dichloroethyl ether, and others are injected into or mixed with infested soil. The toxic gases released rid the soil of the wireworms and other noxious organisms. Soil fumigation should be extremely practical because it would lend itself to most conditions and most of the soil fumigants have been found effective and useful. However, fumigating the soil is not practical for potato growers in New York and is therefore not recommended. Some of the objections to soil fumigants are their cost, mechanical difficulties in application, and toxicity to the crop.

Seed treatments with poisons and repellents have not proved of any value. Many of these materials quickly lose their repellency before the sprouts develop resistance to wireworm attack. The protection of the potato seed piece does not protect the developing tubers after the mother tuber has disappeared from decay. Very few substances used as seed treatments are either repellent or toxic to wireworms.

CULTURAL AND ROTATIONAL PRACTICES

Cultural and rotational practices are among the oldest and most commonly recommended methods for control of the wheat wireworm. Some of these practices are extremely effective in reducing damage and are practical because they can be fitted into the general farming systems. Wireworm control through proper revision of the potato rotations is being effectively used by growers.

The abundance of wheat wireworms in grasslands and long-standing sod crops has been often noted by investigators and potato growers. As early as 1867, Fitch (1867) in his eleventh entomological report stated that "it may be received as an axiom that wherever grass will grow the wireworms may be found for the roots of the various species all afford sufficient nourishment for their support." He then recommended that farmers follow meadows or sod with at least three years of cultivated crops before planting corn or potatoes. Many other workers since that time have suggested that the best method of control for the wheat wireworm is continued cultivation of infested fields.

One of the common potato rotations in New York, particularly in dairy-farming regions, includes three crops, sod (clover and timothy), potatoes, and spring grain. This rotation cycle requires three to four years for completion. Although the progression and kinds of crops vary from farm to farm, potatoes usually follow sod or hay crops. This system is well adapted to dairy-farming and is commonly used by the growers with small acreages. On the large potato farms potatoes are planted continuously or rotated with green-manure soil-building crops. Long-standing and forage crops are not included in these short, more intensive rotations.

In the study of the relation of rotations to wireworm infestation it was necessary throughout the work to obtain representative populations present in each crop of the rotation system. Hence a large number of soil samples were examined for wireworms. The soil was sifted through several screens to facilitate collection of even the smallest individuals. Although this method was slow and laborious, it was found most effective for the field conditions in western New York. At the time of sampling in September and October the wireworms were usually in the upper eight inches of soil. After the wireworms were collected, they were measured and placed in the following classes: first year (3 to 6 millimeters in length), second year (7 to 15 millimeters), and third year (more than 16 millimeters). While larval length is not a positive criterion of age, this system of measurement was sufficiently accurate to meet the needs of field work.

At the outset of the investigations a number of farms were selected for the study of relation of farm crops and rotations to infestation. Through cooperation with the owners, changes in cropping systems and sequence of crops were made when necessary for observation and detailed study. The area of the fields was from 5 to 20 acres, and according to the growers had been infested with wheat wireworms for many years.

FIELD CROPS AND WHEAT-WIREWORM INFESTATIONS

The results of the preliminary field studies show a very definite relation between the crop and the incidence of infestation. In summarizing the data in table 7, the crops surveyed for wireworms are placed in sequence as they occur in the rotation. The first-year larvae occur almost exclusively in sod. Sod crops remaining for a second year are again infested during the second season. Wireworm infestations did not start in either potatoes or spring grain, since these crops are comparatively free of first-year larvae. The larval population in potatoes following sod consists predominantly of second- and third-year wireworms. A year later in the spring-grain crop most of the wireworms in the population are either in the large-size group or have matured and transformed to beetles. The appearance of beetles the next spring will then coincide with the hay crop seeded in the spring grain. In these rotations, sod appears as a crop every third year (3-year rotation), or third and fourth year (4-year rotation). With the completion of the wireworm life cycle in three to four years, potato rotations which include sod every third and fourth year are continuously reinfested.

TABLE 7. RELATION OF THE COMMON ROTATION SYSTEMS IN WYOMING COUNTY TO WIREWORM POPULATION AND SIZE OF WIREWORMS

Year	Crop	Total population	Beetles	Third-year larvae	Second-year larvae	First-year larvae
1930	Sod					
1931	Potatoes					
1932	Grain					
1933	Sod	465	43	59	14	349
1930	Potatoes					
1931	Grain					
1932	Sod					
1933	Potatoes	1025	22	625	371	7
1930	Grain					
1931	Sod					
1932	Potatoes					
1933	Grain	733	233	437	63	0
1930	Potatoes					
1931	Grain					
1932	Sod					
1933	Sod	542	9	26	245	262

SUSCEPTIBILITY OF CULTIVATED AND SOD PLOTS TO INFESTATION

The relative susceptibility of cultivated and sod fields to infestation is shown from a series of small-plot experiments. Small areas in six sod fields were plowed, fitted, and planted to crops such as potatoes, beans, and grain, referred to as *cultivated crops*. These plots alternated with sod plots of the same size and were replicated. In the fall representative soil samples were examined, and wireworms measuring 3 to 6 millimeters were recorded and considered as first-year larvae. A striking contrast of populations in the sod and cultivated plots may be noted from table 8. The number of first-year wireworms in the sod plots was many times the populations in corresponding cultivated plots.

TABLE 8. A COMPARISON OF FIRST-YEAR-WIREWORM POPULATIONS IN SMALL PLOTS PLANTED TO SOD AND CULTIVATED CROPS

Field	Crop	Number of replications	Number of samples	Number of first-year larvae	Population per acre
1	Sod	4	29	139	52,272
	Cultivated	4	29	1	376
2	Sod	3	18	65	39,204
	Cultivated	3	18	0	0
3	Sod	4	20	109	60,984
	Cultivated	4	20	3	1,612
4	Sod	2	20	182	100,188
	Cultivated	2	20	2	1,089
5	Sod	2	26	91	50,529
	Cultivated	2	13	0	0
6	Sod	2	12	234	284,447
	Cultivated	2	8	14	25,700

As is sometimes the case, it is possible that these small-plot experiments did not give a true picture of what would happen under average field conditions. As mentioned previously, beetles migrate short distances by crawling over the soil surface. Beetles emerging on the small cultivated plots probably moved to more attractive shelter in the sod plots. In large areas the beetles remained on the fields during the egg-laying period as was the case in the spring of 1935. There was then a question of reinfestation in these fields in which sod had been eliminated from the rotation.

MODIFICATION OF THE POTATO ROTATIONS

Reduction in wireworm population

It is therefore of interest to trace the trends of wireworm populations in fields with modified rotations. Four severely infested potato fields were subsequently cropped continuously with potatoes or spring grain. One heavily infested area in each field was sampled for a number of years following the heavily populated sod. Different but comparable sampling methods were used in the two crops to allow for differences in the distribution of the larvae in grain and hill crops. The census figures summarized in table 9 show rapid decreases in wireworm populations following modification of the rotation by continuously planting either potatoes or spring grain. After three years from the sod crop, the wireworm population had practically disappeared. These fields were not reinfested by new generations of wireworms. Normally reinfestation takes place every third and fourth year coincident with the sod crop.

TABLE 9. CULTIVATION OF INFESTED FIELDS AS AFFECTING THE WIREWORM POPULATIONS AND REINFESTATION OF THOSE FIELDS

Field	Year	Crop	Number of samples	Number of beetles	Number of mature and second-year larvae	Number of first-year larvae
1	1929	Sod				
	1930	Potatoes	13	1	119	0
	1931	Potatoes	13	19	83	0
	1932	Grain	13	10	17	0
	1933	Potatoes	13	0	3	0
2	1930	Sod	13			
	1931	Potatoes	13	1	88	0
	1932	Potatoes	13	42	23	0
	1933	Potatoes	13	6	9	1
	1934	Potatoes	13	2	3	0
	1935	Potatoes	13	0	1	0
3	1931	Sod	20			
	1932	Potatoes	20	..	96	0
	1933	Potatoes	20	..	35	0
	1934	Potatoes	20	..	6	0
	1935	Potatoes	20	..	2	0
4	1929	Sod	13			
	1930	Potatoes	13	0	121	0
	1931	Grain	13	33	88	0
	1932	Potatoes	13	18	9	0
	1933	Grain	13	0	2	2

Reduction in wireworm injury to potatoes

A decline in the wireworm populations following the elimination of sod from the potato rotation is correspondingly reflected in the injury. The heavy infestations of wireworms which had originated in the sod crop caused severe injury to the first crop of potatoes. Injury decreased sharply thereafter and became practically nil after three years of cultivated crops, as indicated in table 10.

TABLE 10. REDUCTION OF WIREWORM INJURIES TO POTATO TUBERS FOLLOWING ELIMINATION OF SOD FROM THE ROTATION

Field	Year	Crop	Per cent of injury to potato tubers
1	1929	Sod	
	1930	Potatoes	92.0
	1931	Potatoes	17.7
	1932	Grain	......
	1933	Potatoes	0.04
2	1930	Sod	
	1931	Potatoes	85.0
	1932	Potatoes	4.0
	1933	Potatoes	0.75
	1934	Potatoes	1.7
3	1931	Sod	
	1932	Potatoes	77.7
	1933	Potatoes	57.1
	1934	Potatoes	2.8
	1935	Potatoes	2.04
4	1929	Sod	
	1930	Potatoes	100.0
	1931	Grain	......
	1932	Potatoes	10.4
	1933	Grain	......

Present rotation projects

The studies on the relation of rotation to wireworm injury has been expanded to include other insects, diseases, yields, and other phases of potato-growing. The Departments of Vegetable Crops, Plant Pathology, and Agronomy, at Cornell University, are cooperating in these projects, started in 1936 and located in three widely separated areas of the State. One plot field is near Malone in northern New York, another in Genesee County, and the third in Steuben County.

Nine different rotation systems are being compared in each plot field. Each experiment includes a large number of small plots covering approximately four acres. An airplane view of the plots in Steuben County is shown in figure 12.

Heavy infestations of wheat wireworms are present in two of the experiments. Results of tuber injury to date confirm the previous work as reported in this bulletin. Infestations start in the clover-timothy plots and potatoes planted in these plots are severely injured. The short rotations that do not include sod have not been susceptible to infestation and the amount of wireworm damage has been low as compared with the injury in long rotations.

NATURAL ENEMIES OF THE WHEAT WIREWORM

The efficiency of natural enemies in reducing wireworm infestation is difficult to evaluate under field conditions. Wireworms in their subterranean habitat are not only admirably protected from their enemies but are also concealed from observation. It is therefore difficult to determine the agencies responsible for natural reduction under field conditions.

Wireworms are, however, subject to destruction from parasites and predators. Birds and predacious insects prey on all stages of Elaterids, particularly the beetles during the flight period. Parasitism is commonly reported in the beetles. Disease is troublesome in rearing cages, sometimes destroying entire populations. Several fungi have been isolated

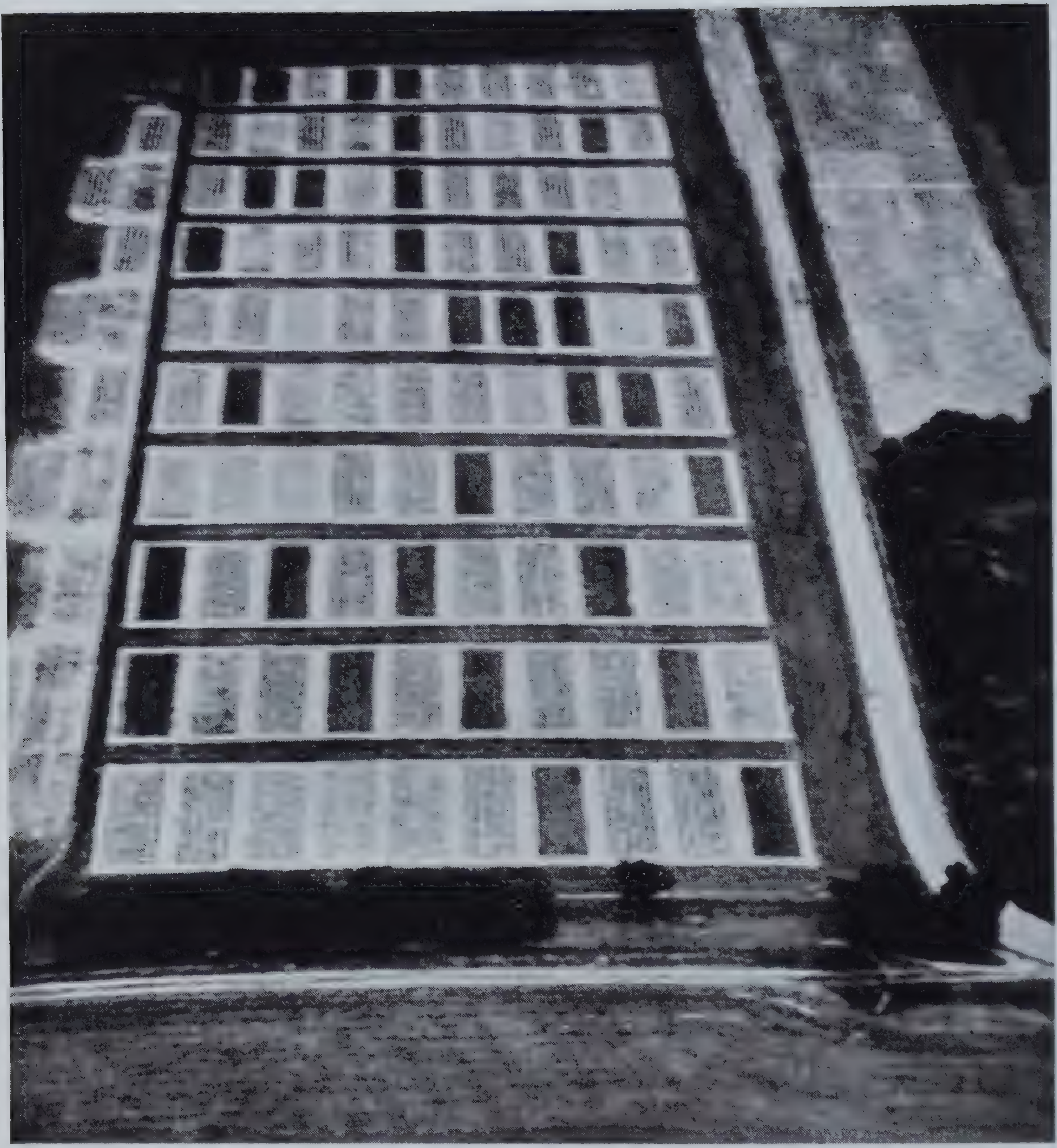


FIGURE 12. AERIAL VIEW OF THE POTATO-ROTATION TRIALS ON THE FARM OF C. D. WOLCOTT AND SON, COHOCTON, NEW YORK

The experimental plots cover an area of approximately four acres

from diseased specimens but apparently the pathogenicity of these fungi has not been thoroughly established.

In analyzing the data accumulated from the yearly wireworm census of a number of fields, an unaccountable reduction was noted in populations from year to year. Referring to table 11, if no mortality occurred during a year, the total population, beetles and larvae, would closely approximate the larval population of the previous year. For instance, in field 1 the total population (65) of the second-year crop of potatoes was 23 less than the number of larvae recorded in similar samples of the previous year. Similar reductions of 10 to 75 per cent were noted in six of seven cases, and indicate that considerable natural mortality occurs from year to year.

TABLE 11. REDUCTIONS OF WIREWORM POPULATIONS BY NATURAL FACTORS UNDER FIELD CONDITIONS

Field	Crop	Number of samples	Number of beetles	Number of larvae	Reduction of population	
					Number	Per cent
1	Sod					
	Potatoes	13		88		
	Potatoes	13	42	23	23	26.14
	Potatoes	13	6	9	8	34.78
2	Sod					
	Potatoes	13		119		
	Potatoes	13	19	83	17	14.29
	Potatoes	13	10	17	56	67.47
3	Sod					
	Potatoes	13		121		
	Grain	13	33	88	0	0.0
	Potatoes	13	18	9	61	69.32
4	Sod					
	Potatoes	15		214		
	Potatoes	15	18	36	160	74.77

Although sampling errors may have been considerable, the magnitude of the decreases is such that sampling variations probably do not account for the reductions. The natural agencies responsible for the observed decreases are not known since dead larvae were seldom found in the field. Natural mortality is generally considered to be only partially effective in wireworm control, and artificial methods have to be used to reduce populations.

SUMMARY

The importance of the potato-tuber-defect problem in upstate New York is indicated from field surveys made during 1931 and 1932. These surveys show that more than one-half of all the tubers examined were injured by insects, diseases, and the mechanical operations of harvest. Wireworm injury was one of the most important of the defects.

Three species of wireworms are commonly found in potato fields. Of these three, the wheat wireworm (*Agriotes mancus* Say) is the most abundant and injurious. The other two species, the eastern field wireworm (*Limonius ectypus* Say), and the corn wireworm (*Melanotus* sp.), while not as widespread as the wheat wireworm, are nevertheless injurious in many potato-producing areas.

All portions of the potato plant, seed piece, stems, stolons, and tubers are subject to injury. Tuber damage as it affects the market quality of the crop is of chief concern to the grower. Wireworms burrow into the tuber flesh, leaving tunnels which cause excessive waste when injured potatoes are prepared for the table. There are a number of variations of wireworm injury caused by growth of the tuber after injury or invasion by soil organisms into the tunnels.

A study of the biology and control of the wheat wireworm was made during a six-year period from 1930 to 1936. The life cycle is three to four years in length. Eggs are laid in the soil from June to July and hatch in approximately three weeks. The wireworms grow slowly to larval maturity in two to three years. Pupation then occurs from late July through

August and concludes with the appearance of the beetles, which remain in their pupal cells over the winter.

Infestations of wheat wireworms start in grass and sod crops. Potatoes, corn, and similar crops are not subject to new infestations. The common potato rotation in upstate New York includes a sod crop every third and fourth year. Potatoes generally follow the sod. The appearance of the beetles during the third and fourth years of the life cycle occurs simultaneously with the sod crop in the rotation. Potato crops in this rotation are therefore usually infested.

Marked reductions in wireworm populations and in resultant damage to potatoes followed elimination of the sod crop from the potato rotation. Continuous use of cultivated crops on infested fields reduced wireworm injury to a minimum after three years. The control of wheat wireworms by short rotations is not due to mechanical action of cultivation but rather to unfavorable conditions for oviposition and survival of the young larvae in cultivated crops. Such short rotations should include crops that can be tilled during the egg-laying period during June and July.

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Biology and Control of the Wheat Wireworm, *Agriotes Mancus* Say

W. A. Rawlins

WHEAT WIREWORMS

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BIOLOGY AND CONTROL OF THE WHEAT WIREWORM, *AGRIOTES MANCUS* SAY.[1]

W. A. Rawlins

One of the most important potato problems of upstate New York is the production of tubers free of the blemishes which render them of poor marketable quality. In recent years consumer demand for better and more uniform potato grades has stimulated grower interest in careful grading and packaging. Consumer discrimination against inadequately graded potatoes and subsequent loss of many choice markets have focused growers' attentions on potato defects, and their causes and measures of control.

These defects may be either of an external or an internal nature. Diseases and physiological changes cause various internal disorders that are not commonly noted on the surface. Defects that cause "rough" potatoes are the result of insects, diseases, unfavorable growing conditions, and the mechanics of handling from digger to grader.

A number of insects and allied forms feed on potatoes and produce various kinds of blemishes. In a previous publication (MacLeod and Rawlins, 1933) some of the more common injuries were illustrated and described in detail. Typical injuries were not always apparent in the field because one kind of defect was often masked by another. For instance, millipedes (*Julus* sp.) and scab-gnat maggots (*Sciara* sp. and *Pnxyia scabei*), commonly associated with potato scab, have been found to feed on and completely obliterate certain types of scab lesions. Their injuries are apparently of a secondary nature although there are reasons to believe that scab lesions are deepened or pitted by the invasion of millipedes and scab gnats. The scars, tunnels, and cavities caused by the feeding of wireworms and white grubs are chiefly primary; that is, without respect to other injuries. While each typical injury is distinct, the occurrence of many different types on the same tuber causes a confusing complex.

FIELD SURVEYS

A perspective of this tuber-defect problem may be obtained from field surveys made during the fall seasons of 1931 and 1932. With a number of departments cooperating in these studies and interested in particular phases of the problem, detailed and thorough investigations were made possible. Strictly from the entomological standpoint, it was essential to determine the factors concerned in the distribution of tuber defects and the causative organisms involved. The data obtained not only gave information on the extent of the defect problem but also were used as a basis for experimental field work.

The procedure of the survey was simple. Representative farms in the various potato-producing areas of the State were visited during harvest time and the tubers examined before being picked up in the field containers.

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[1] The material presented in this bulletin is a resume of a thesis offered to the faculty of the Graduate School of Cornell University, June 1936, in partial fulfillment of the requirements for the degree of doctor of philosophy.

AUTHOR'S ACKNOWLEDGMENTS. The writer is most grateful to Dr. G. F. MacLeod, formerly at Cornell University, for his direction, advice, and encouragement during the course of this work. The keen interest and generous cooperation of potato growers and county agents are also appreciated.

At least twenty samples of five tubers each were selected at random and all the injuries were recorded as to severity and classification. In many instances where more than one soil type existed in the same field, data were collected for each type.

Generally one or more kinds of injury were found in each field, and frequently tubers were damaged with a variety of injuries. The summarized records express in table 1 the relative proportions of the most common defects, exclusive of mechanical injuries, present on the tubers examined. Inasmuch as a large number of fields in most of the upstate potato-producing sections were visited, the survey data accurately indicate the gravity of the defect problem at the beginning of the present investigations.

TABLE 1. PERCENTAGES OF POTATO-TUBER DEFECTS FROM SURVEYS AT HARVEST TIME IN UPSTATE NEW YORK

County	Number of records	Uninjured	Scabby	Rhizoctonia	Wireworms	Gnats	Millipeds
Summary for 1931							
Wyoming	23	46.5	4.5	28.1	19.1	7.7	4.2
Allegany	13	62.4	2.2	20.5	8.7	5.6	1.8
Steuben	26	53.5	3.6	17.1	16.4	7.6	14.6
Erie	12	52.3	....	13.5	19.9	8.4	6.1
Genesee	11	48.6	24.2	19.1	7.9	11.9	11.9
Monroe	18	27.7	17.4	16.8	40.9	15.3	18.2
Ontario	10	30.0	25.7	21.1	16.7	30.7	24.3
Onondaga	10	38.4	24.4	20.0	8.8	19.0	22.9
General average		45.7	11.3	17.5	18.7	11.9	12.2
Summary for 1932							
Clinton	21	39.9	28.5	6.6	17.8	7.0	.2
Franklin	10	47.7	9.8	20.6	17.1	3.2	.7
St. Lawrence	1	38.0	47.0	8.0	10.0	16.0	3.1
Wyoming	8	38.5	11.3	33.6	18.0	13.8	3.8
Steuben	11	41.1	3.3	26.2	33.2	8.6	10.4
Allegany	10	43.0	10.1	26.4	34.3	2.9	3.5
Erie	8	43.1	10.5	7.2	15.9	12.3	37.3
Genesee	13	36.7	19.7	27.2	18.6	11.5	12.6
Monroe	11	13.7	38.4	38.3	31.6	28.1	4.8
Ontario	10	34.2	21.7	25.9	23.0	21.6	13.4
Oswego	13	24.5	10.2	52.8	26.8	8.9	9.8
Onondaga	8	56.4	9.5	17.5	13.1	9.0	8.9
Oneida	9	58.9	10.1	17.1	11.0	10.3	11.9
General average		42.4	15.6	22.6	20.8	10.8	9.6

For the two years 1931 and 1932, referring again to table 1, more than one-half of all the tubers examined were damaged by insects and diseases. Of these injuries, excepting Rhizoctonia which produces a superficial flecking on the surface of the tuber and is therefore not a severe defect, wireworm injury was the most serious and widespread. In the respective two years 18.7 per cent and 20.8 per cent of the tubers were injured by wireworms. The injury was quite generally distributed throughout the State, although it was more important in some counties than in others. Even within neighborhoods the amount of wireworm injury varied considerably from farm to farm. It has been a common experience to find heavily infested fields with seriously injured potato crops near or bordering fields that were comparatively free of the pest.

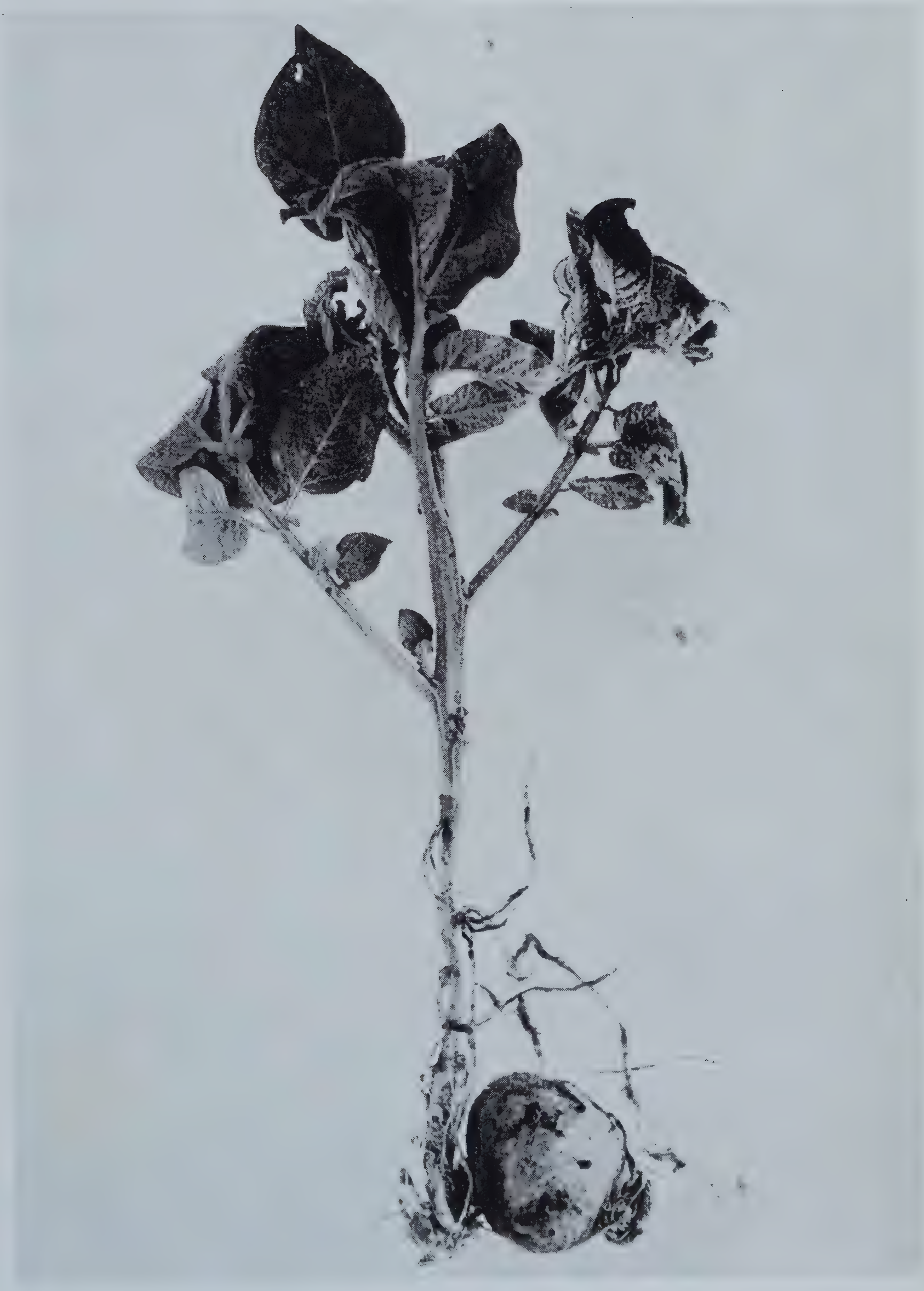


FIGURE 1. WIREWORM INJURY TO THE SEED TUBER
The tunnel entrances can be seen on the uncut surface

WIREWORM INJURY TO THE POTATO PLANT

The underground portions of the potato plant, seed piece, stems, stolons, and tubers are subject to wireworm attack. While injury is usually severe on all these parts, from the production standpoint damage to the tubers is the most noticeable and significant. The damage to tuber quality represents a much greater loss to the potato grower than does reduction in yields caused by wireworms feeding on seed piece and plant.

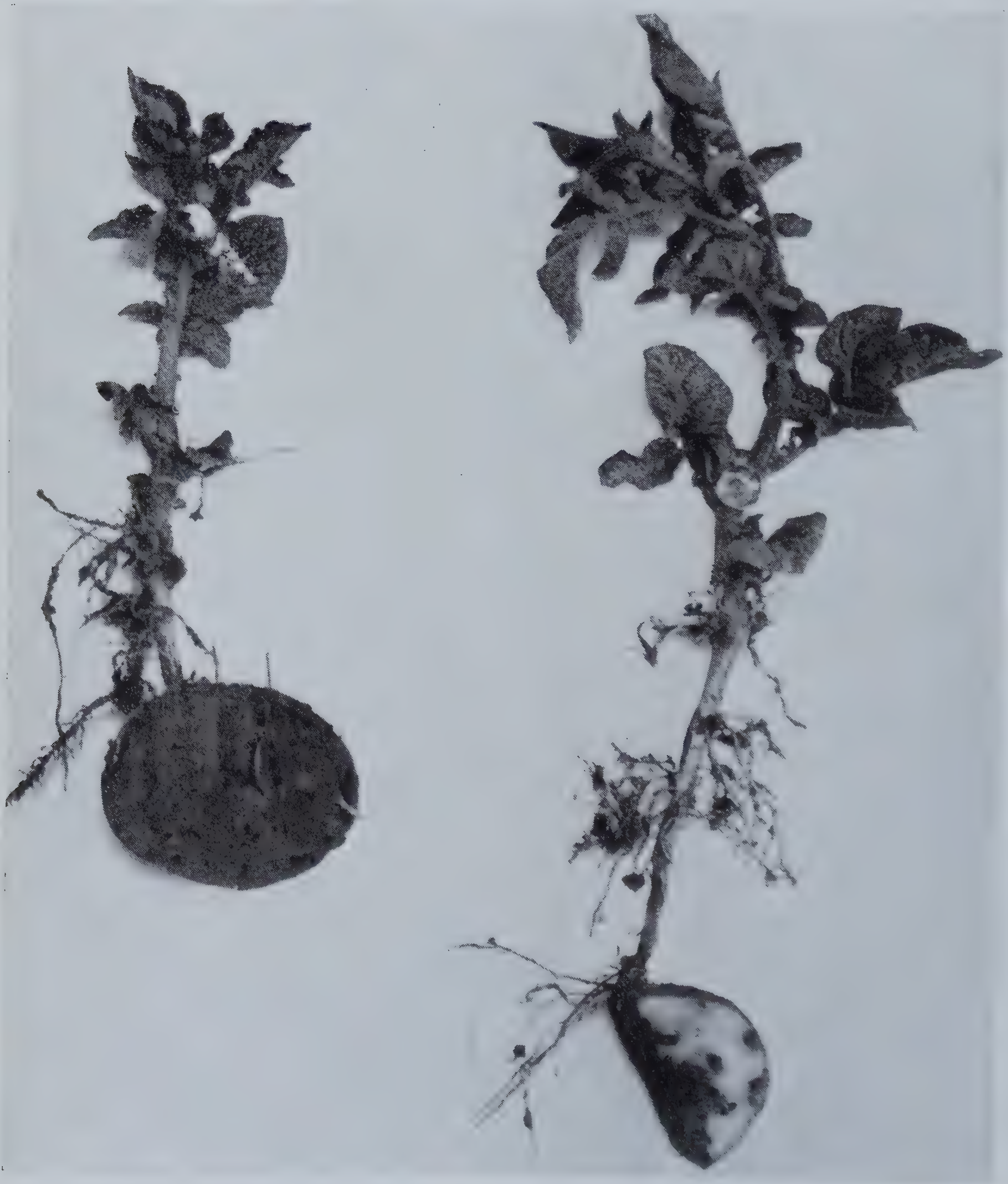


FIGURE 2. SEVERE INJURY TO THE POTATO SEED PIECE
Wireworms tunnel and honeycomb the interior

Seed-piece injury

Soon after planting, wireworms attracted by the seed pieces migrate to the potato hill where they immediately enter the mother tuber (figure 1). Within a short time seed pieces become interlaced with numerous tunnels which, in cases of prolonged feeding, leave the interior completely honeycombed (figure 2). The mother tuber remains attractive to the wire-

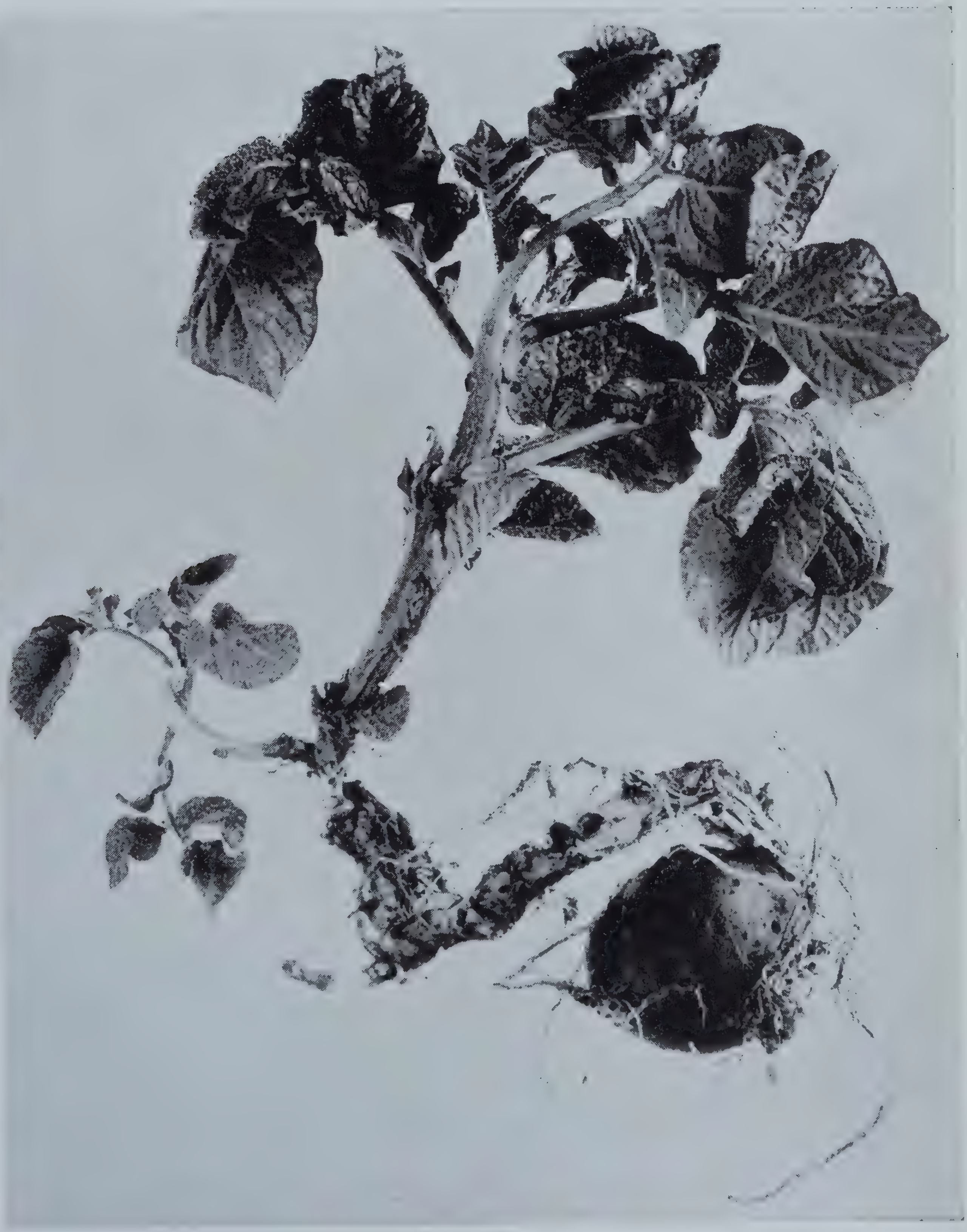


FIGURE 3. A GIRDLED STEM OF A POTATO PLANT, CAUSED BY THE FEEDING OF WIREWORMS

worms until the flesh completely disintegrates. Even then, some larvae remain in the rotted spongy interior, which at this time probably contains very little food material. Wireworm feeding on the seed piece not only reduces the tissue in which are stored nutrients for plant growth but also creates entrance points for bacteria and rot fungi, thus promoting rapid seed-piece decay.

Stem injury

The stem is subject to attack from the time the sprout forms until the stalk becomes hard and woody. Injury is usually slight except in cases of heavy wireworm infestations. Much of the stem-feeding occurs after the seed piece has decayed. The wireworms are then no longer attracted to the seed piece and turn their attentions to more favorable food. Although slight scarring of the stem does not seem to cause any depression in growth of the plant, severe injury results in the girdling or severing of the stem (figure 3). Girdled plants make a stunted abnormal growth similar to that resulting from injury by Rhizoctonia disease or by mechanical abrasion. Many small irregularly shaped tubers are produced immediately below the soil surface and frequently aerial tubers form in the leaf axials (figure 4). Such hills are worthless.

Tuber injury

Since the tubers are the crop, tuber injury is the most important of the damage to potatoes and the chief concern to the grower. Wireworms bore into the tubers leaving scars and holes on the surface. The tunnels extend to varying depths into the tuber flesh and may be so numerous that the tubers are completely honeycombed. There are several types of wireworm injury. Enlargement of the tunnels through continued tuber growth after injury or through invasion by soil organisms, causes variations from the typical and more familiar type of injury. For example, the tunnels in newly set and rapidly growing tubers become enlarged with tuber expansion and appear as funnel-shaped cavities characteristic of early wireworm injury (figure 5, A). Tunnels made when the potatoes have matured appear on the surface as small, round, clean-cut holes. This injury, designated as the late seasonal type (figure 5, B), is most typical of wireworm damage. A third variation of injury is locally referred to by growers as *pitting*. Characteristic of pitting are the dark, ragged, cankerous areas at the edges of the holes (figure 5, C), caused by the invasion of the tunnels by Rhizoctonia and other soil fungi. The term for this type of wireworm injury is loosely applied, inasmuch as any defect of a pitted nature, not necessarily caused by wireworms, is often called pitting. Certain other types of wireworm injury occur but are not common. Occasionally tubers are covered with numerous small "warts", or galls (figure 5, D), resembling to some extent enlarged lenticles. These "warts" may be formed, as a response to wounding, through abnormal tissue growth, with the result that the edges of the tunnels protrude slightly. Millipeds and scab-gnat larvae commonly enter wireworm holes and leave additional defects characteristic of their feeding. These various surface scars give injured tubers a rough, spotted appearance. However, it is the network of tunnels within the tuber which causes excessive and annoying waste when injured potatoes are prepared for the table. For this reason wireworm damage is one of the most important of the tuber defects.

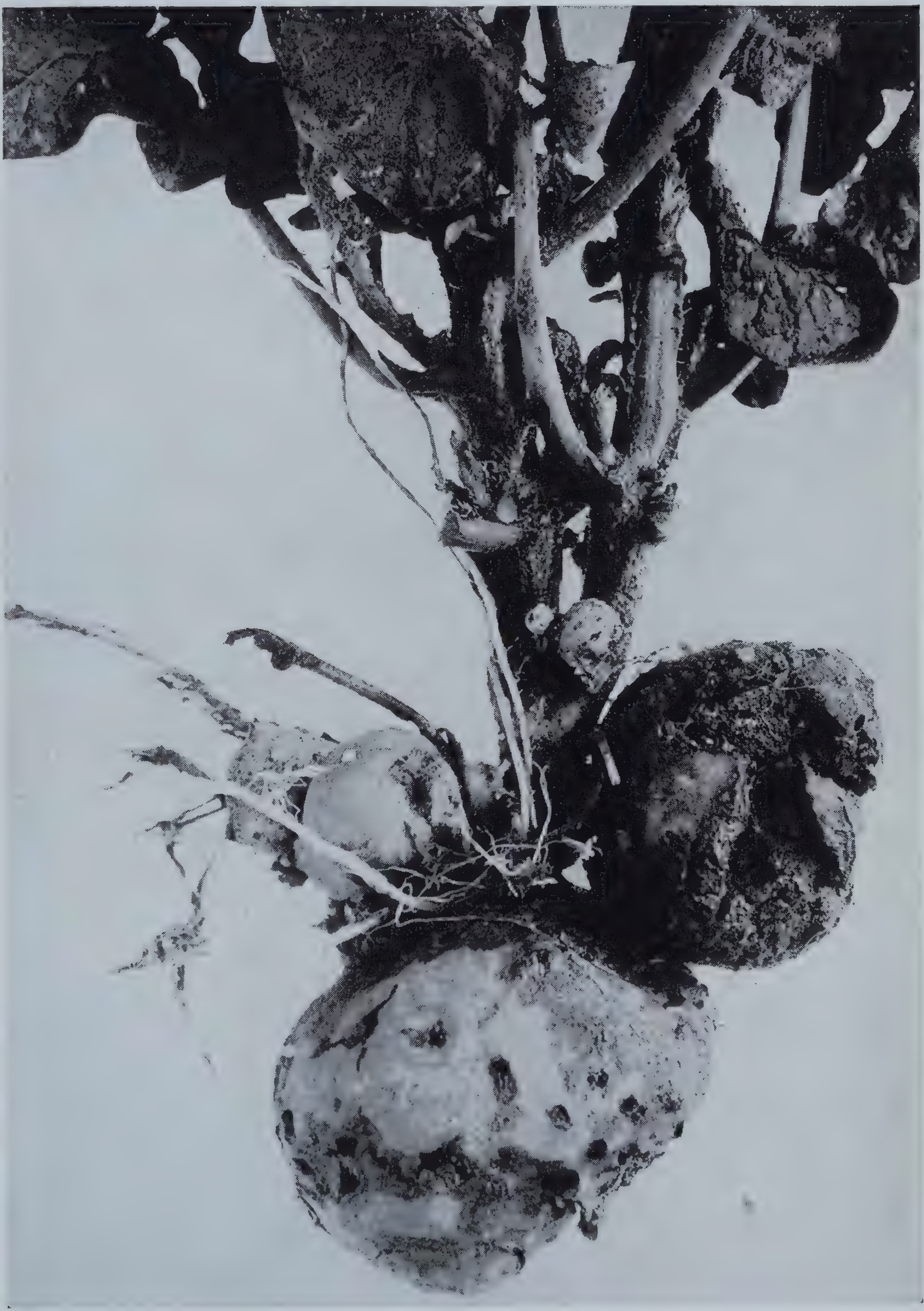


FIGURE 4. INJURY TO THE NEWLY FORMED TUBERS
These tubers will be small, misshapen, and worthless

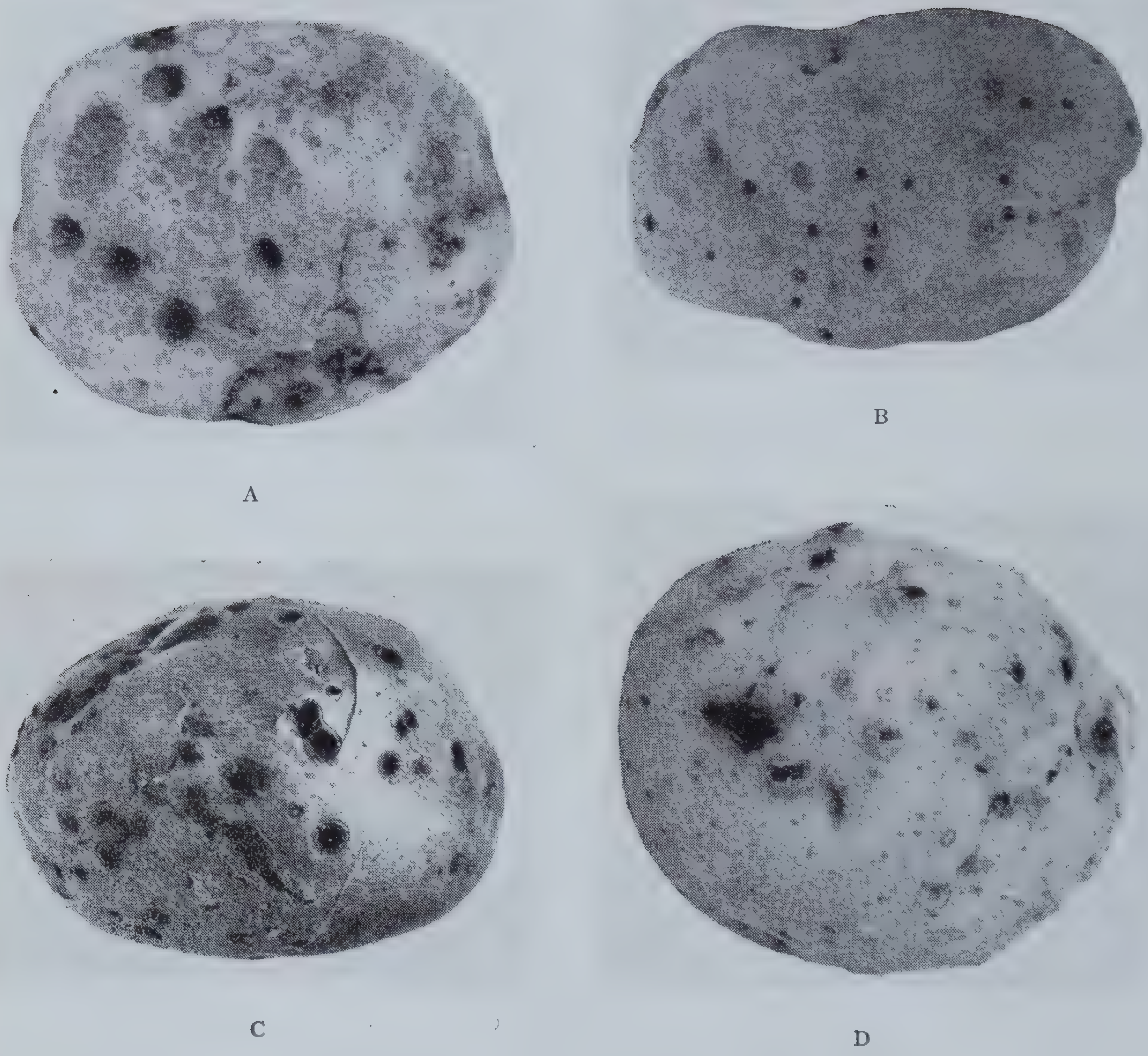


FIGURE 5. WIREWORM INJURY TO POTATO TUBERS

A. Early injury
B. Late injury
C. Pitting
D. "Pimples"

WIREWORMS IN POTATO FIELDS

Although 200 species of Elaterids have been recorded in New York State, only a few of these were commonly found in potato fields. The most abundant ones listed in order of their importance are the wheat wireworm (*Agriotes mancus* Say), the eastern field wireworm (*Limonius ectypus* Say), and the corn wireworm (*Melanotus* sp.). The abbreviated wireworm (*Cryptohypnus abbreviatus* Say), and the wireworm (*Aeolus mellillus* Say), occasionally were numerous but caused little or no damage to potatoes. In two instances while making wireworm surveys in potato fields, populations of abbreviated wireworms were as high as five larvae in each potato hill, but no tuber injury was evident. Generally these wireworms occur with populations of the more injurious species or in similar habitats.

Recent studies of the more common wireworms have quite clearly indicated that they differ considerably in life history and habits. This is important from the practical control standpoint because the most promising and most practical control measures are based upon certain peculiarities in the habits of these wireworms. Therefore, control measures used against one wireworm may not be effective against another species. Hence, it is important for potato growers to acquaint themselves with the distinguishing characters of these wireworms to properly diagnose their wireworm problems. Little difficulty should be encountered since the larvae of each species belong to a different and easily distinguishable group. For practical purposes, color of the wireworm and the shape of the ninth, or last conspicuous, abdominal segment will serve as identifying characters. The wireworm larva has ten abdominal segments, the last of which is small and lies below the larger ninth segment. In actuality the ninth segment, when viewed dorsally, appears to be the caudal segment. The three important wireworms are illustrated in plate I and in figure 6, which indicate comparative differences in larval characters referred to in the descriptions which follow.

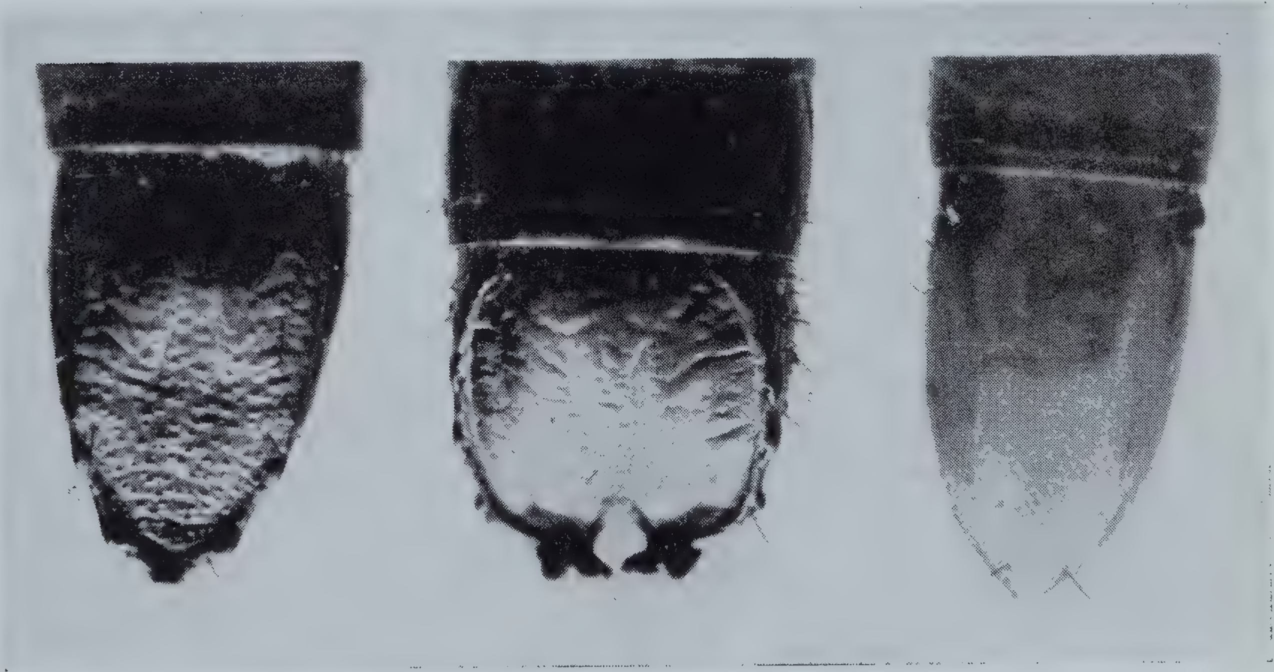


FIGURE 6. THE NINTH ABDOMINAL SEGMENTS OF THE THREE WIREWORMS MOST INJURIOUS TO POTATOES

Left to right: corn wireworm (*Melanotus* sp.); eastern field wireworm (*Limonius ectypus* Say); wheat wireworm (*Agriotes mancus* Say)

Differences in the beetles are not so outstanding as in the larval stages, although size and shape are distinctive characters for those well acquainted with wireworms. Since many species are numerous during the egg-laying and flight period, identification of beetles should be based on careful taxonomical examination. Some idea of the comparative sizes and shapes of the three important Elaterids may be obtained from figure 7.

The wheat wireworm (*Agriotes mancus Say*)

When full grown, the larva, or wireworm, is approximately three-fourths inch to one inch in length, slender, and a waxy light straw color. The caudal margins of each segment are somewhat darker than the remaining portion of the segment; thus, the larva appears ringed. The pointed ninth segment bears two black eyelike spots, or invaginations. This latter character is prominent and easily distinguishable on all of the wireworms belonging to the Agriotes group.

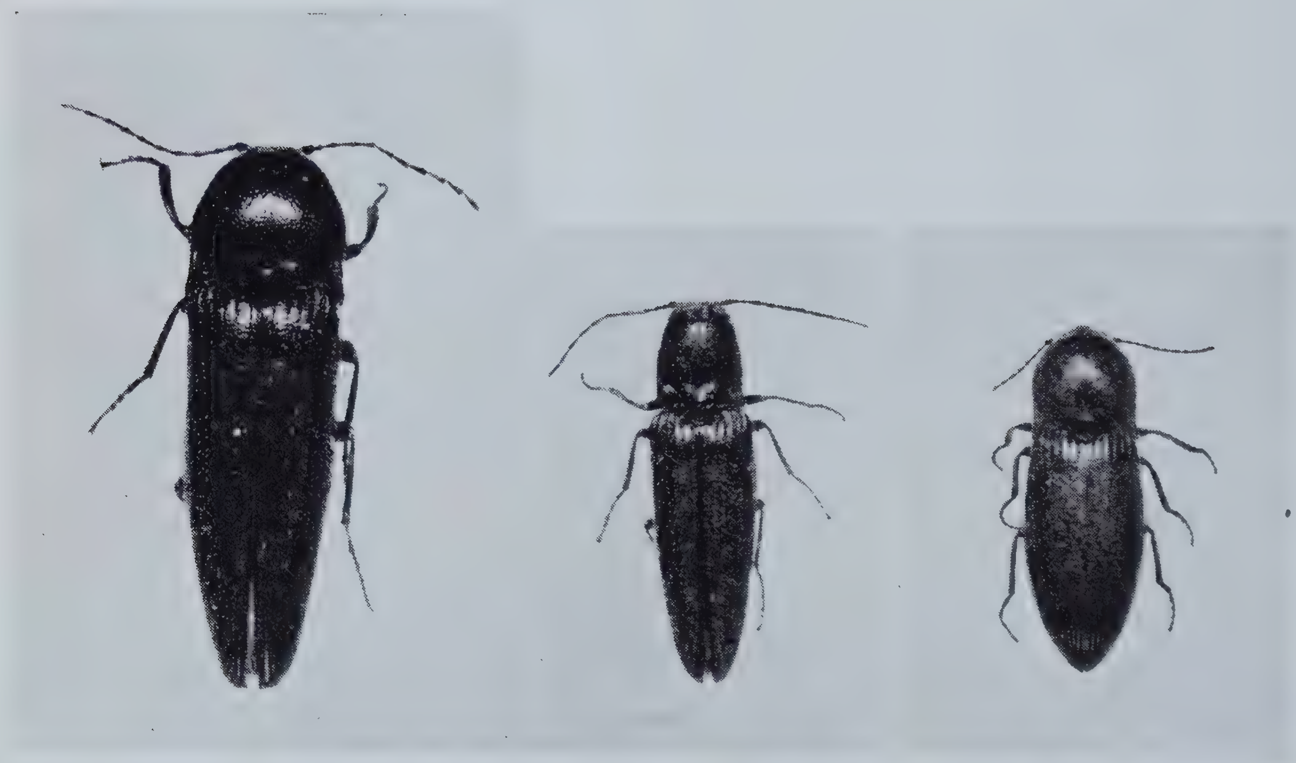


Figure 7. BEETLES OF THE THREE WIREWORMS MOST INJURIOUS TO POTATOES
Left to right: corn wireworm (*Melanotus* sp.), ×3; eastern field wireworm (*Limonius ectypus* Say), ×2½; wheat wireworm (*Agriotes mancus* Say), ×3

The beetle of the wheat wireworm is about one third of an inch in length, robust, and dark brown in color. The color varies somewhat from a light brown to almost black but is usually a dark shade. In the field, beetles are generally found near moisture under stones and clods of soil. They are rather inactive and are seldom noted moving about or in flight.

The eastern field wireworm (*Limonius ectypus Say*)

The eastern field wireworm, when mature, is also approximately an inch in length and is more robust than the wheat wireworm. It is darker in color, being a light tan. The ninth segment is distinctive. It is flattened dorsally and divided into two lobes, the points of which curve inward similarly to a pair of calipers. This larval character is found in a number of other species, and hence they may be confused with the eastern field wireworm. However, these other wireworms are rarely abundant and are not important as pests of potatoes.

The beetle of the eastern field wireworm is approximately seven-sixteenths of an inch in length and dark brown in color. Males are usually somewhat smaller than the females and are more slender. This species is more active than the wheat wireworm and is often noted in flight.

The corn wireworm (*Melanotus sp.*)

The corn wireworm is the largest of the three species. It is more than an inch in length and glossy red brown in color. The ninth segment is flattened dorsally and slightly scalloped along its lateral margins. The beetle is slightly more than one-half of an inch in length and glossy dark brown to black in color. It is wedge-shaped because the elytra narrow gradually from the base of the wide thorax. This is a distinctive character of most of the beetles belonging to the Melanotus group.

Distribution

These wireworms are widely distributed throughout the State in most potato-growing regions. Fortunately, few instances have been recorded of mixed infestations in which two or all three species were present in large numbers. Ordinarily, infestations are predominantly one species with an occasional wireworm of another kind. In a few cases heavy populations of both wheat and corn wireworms were found in the same fields. To date, survey records show that eastern field wireworms are seldom intermixed with other species. Of the three wireworms, the wheat wireworm is most abundant and widely distributed, probably accounting for most of the wireworm damage to potatoes in the State.

The regions and soils infested by the various species of wireworms differ greatly. The wheat wireworm is usually found in the heaviest soil types, the silt and clay loams of the dairy-farming regions where sod crops are an important part of the potato rotation. Corn wireworms are found most abundantly in orchard and meadow sods that have been left standing for many years. Occasionally light infestations occur in fields that are rotated frequently with cropping systems that include clover and timothy sod. Eastern field wireworms infest sandy soils almost exclusively. This interesting relationship has been noted in fields with zones of light and heavy soil types. Infestations were restricted to the sandy soils, with the result that injury to crops on these areas was severe, whereas on the heavier soil areas injury was nil.

Although all the above-mentioned wireworms feed on potatoes, the amount of damage varies with the species. This is strikingly brought out from examinations made in many potato fields in western New York. This survey was made in 1934 as a study of the relationship of infestation to injury. Potato hills in a number of fields were selected at random, the injured tubers counted, and the soil sifted for wireworm larvae. When more than one species was found in a hill, that hill was discarded and not considered in the data. In summarizing the data (table 2), the numbers of wireworms found were placed in four groups (1 to 2, 3 to 5, 6 to 9, and more than 10 wireworms to a hill). The data from knoll and low areas were recorded separately since wireworm populations and damage in these different sites make an interesting comparison. The amount of damage

TABLE 2. COMPARISONS OF NUMBERS OF WIREWORMS IN RELATION TO FREQUENCIES OF POTATO TUBER INJURIES

	Number of wireworms			
	1 to 2	3 to 5	6 to 9	10 or more
Eastern field wireworms:				
High areas	1:12	1:14	1:4	1:5
Low areas	1:6	1:5	1:4	1:4
Wheat wireworms:				
High areas	1:3	....	....	....
Low areas	1:2	2:3	3:4	6:7
Corn wireworms:				
High areas	1:5	....	....	....
Low areas	1:2	1:1	1:1	1:1

caused by any one population group is expressed as a ratio of injured to uninjured tubers. Thus the ratio 1 : 10 indicates that one tuber in ten was injured by wireworms. Judged on this basis, wheat wireworms and corn wireworms were most destructive because they injured a proportionately greater number of tubers than did the eastern field wireworms. For example, 3 to 5 wheat wireworms to a hill injured two of every three potatoes, whereas the same number of eastern field wireworms injured only one of every five tubers.

It is interesting too (table 3), that the knoll areas were only slightly infested with wheat and corn wireworms. Hill populations of more than 1 to 2 wireworms were not found in these areas. Eastern field wireworms infested nearly all parts of the field although low areas generally had higher populations than had knoll areas.

TABLE 3. Comparative Numbers of Five Species of Wireworms in High and Low Areas of Potato Fields

Species	Total numbers of wireworms (360 hills)	
	High areas	Low areas
Limonius ectypus Say	182	234
Agriotes mancus Say	25	258
Melanotus communis Gyll	14	112
Cryptohypnus abbreviatus Say	12	42
Aeolus mellillus Say	2	15

INVESTIGATIONS ON THE WHEAT WIREWORM

The yearly losses from wireworms aroused intense interest on the part of growers for an intensive and long-time research program. Therefore, investigations were initiated in 1930 with the establishment of a field laboratory near Gainesville in Wyoming County. During the following six years, laboratory and field studies were conducted on the wheat wireworm and the material presented in this bulletin is the summary of these researches.

HISTORY

The wheat wireworm originally inhabited the forests and grasslands before the advent of the intensive agriculture of today. It is probably one of the oldest pests of potatoes and was frequently mentioned by entomologists and agriculturists in their early writings. In these accounts they summarized the then meager and fragmentary knowledge of the biology and control of wireworms, and suggested further methods of control which had proved of value for some of their correspondents. Although much of this information was not based upon careful investigations, many of the observations have been confirmed through later experiments. Many of the early wireworm "remedies" have been handed down to the present day and are often mentioned as valuable adjuncts to the wireworm-control program. The use of salt, for instance, was highly regarded years ago for repelling or killing wireworms and is still suggested by many growers as beneficial. However, careful experiments have definitely shown that salt has no value against wireworms except in amounts toxic to growing crops.

The first extensive researches were undertaken by Comstock and Slingerland (1888, 1891), and their results were published in the first bulletins issued by the Cornell University Agricultural Experiment Station. After engaging in a large number of carefully executed experimental trials they regretfully reported that their experiments had "failed to discover a single satisfactory method of protecting seed, or of destroying immature wireworms in the soil."

Experimental work then lapsed for some years until resumed by Hyslop (1915–1916) who contributed to the knowledge of life history and control. More recently Hawkins (1936) conducted many and extensive studies on the wheat wireworm in Maine and summarized his results in a detailed bulletin from that Station. Wireworm work was again resumed in New York State with the inception of the present project in 1930, the results of which are similar to those published by Hawkins.

BIOLOGY OF THE WHEAT WIREWORM

EGG STAGE

The tiny pearly white eggs (figure 8, A) of the wheat wireworm are laid in crevices of the soil, or under stones and surface debris. They are nearly spherical in shape, unless distorted when squeezed between soil particles in the process of oviposition. The eggs are very small, 0.5 of a millimeter, or approximately 1/50 of an inch, in length, and 0.45 of a millimeter in width.

When the eggs are first laid they are covered with a coating of sticky material which cements soil particles to the egg coverings. In such cases it is practically impossible to distinguish eggs covered with soil from small soil particles. Hence, it is difficult to find the eggs in oviposition cages and in the field.

To overcome this difficulty it is necessary to wash soil containing the eggs through a 60-mesh sieve, which is fine enough to retain the eggs. A gentle stream of water is carefully applied to avoid forcing the eggs through the screen or causing injury. The eggs are then sorted from the debris and lifted out by a blunt dissecting needle or by a camel's hair brush.

A flotation method is useful, especially in field work where large soil samples are handled. The debris and eggs remaining after thorough washing of the samples are mixed with a strong solution of either common salt or magnesium sulfate. The eggs float on the surface of the saline solution and are then readily separated from soil particles, which settle rapidly to the bottom. The eggs should be washed free of the salt to avoid injury to the developing embryos.

After removal of the eggs from the water they may be dried by a short exposure to dry air. However, they are so extremely susceptible to desiccation that exposures of one-half hour to dry air or soil will cause the eggs to lose moisture and collapse. They are then no longer viable.

Determination of hatching is difficult when the eggs are mixed with soil. Because of their small size, magnification is necessary and the separation of newly hatched larvae from the soil mass is time-consuming. A satisfactory method of observing the eggs and at the same time protecting them from molds is to keep them under water. Eggs hatch normally under water and the young larvae remain alive from two to three days.

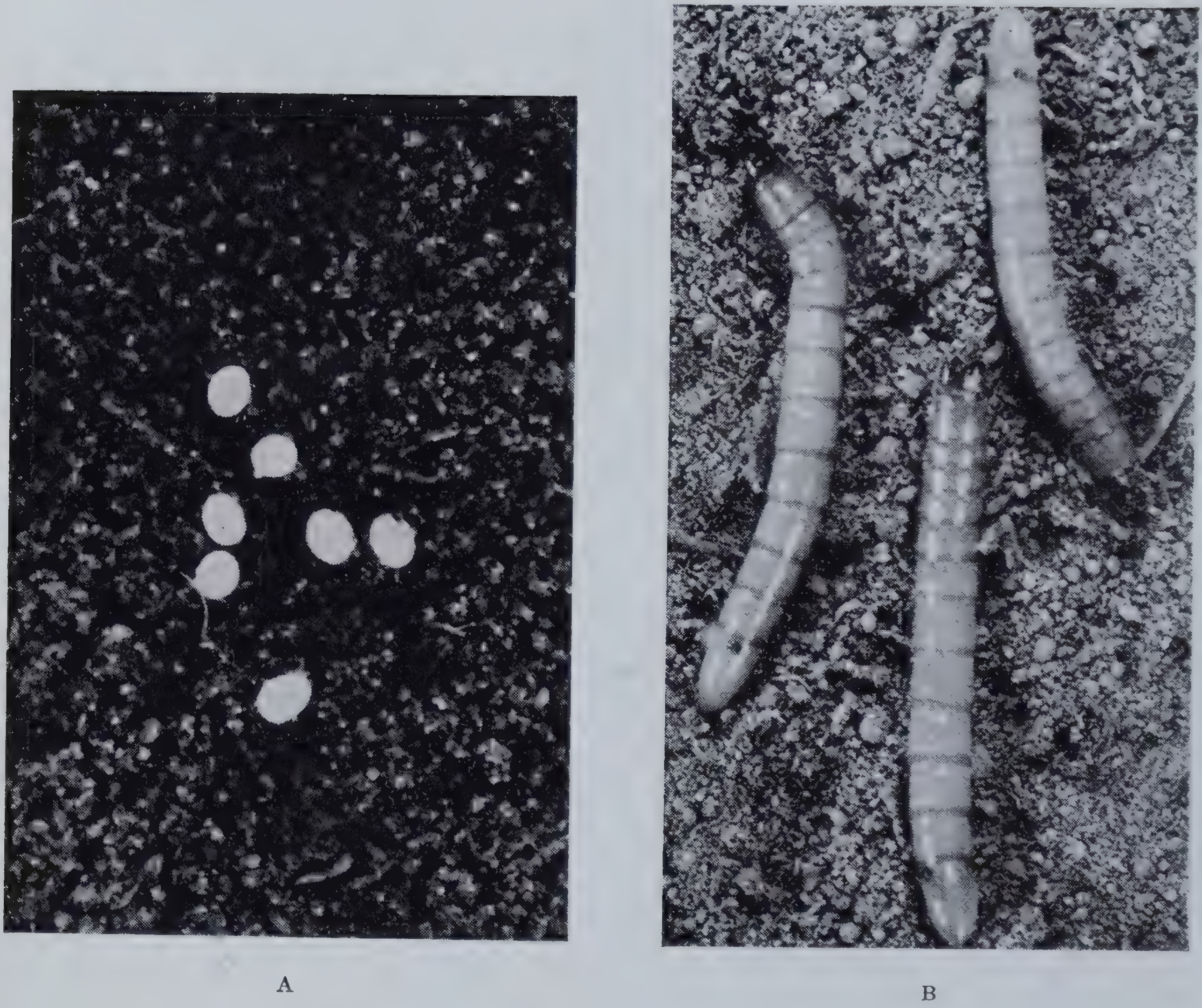


FIGURE 8. EGGS AND LARVAE OF WHEAT WIREWORM

A. The eggs are tiny and pearly white (×8)

B. The characteristic black eyelike spots can be seen on the ninth abdominal segment of the larva (×2½)

Under temperatures prevailing in the field laboratory, the eggs hatched after periods varying from 22 to 28 days. The average incubation period was approximately 25 days. For each batch of eggs laid during a 24-hour period, two to four days elapsed between the beginning of hatching and the end.

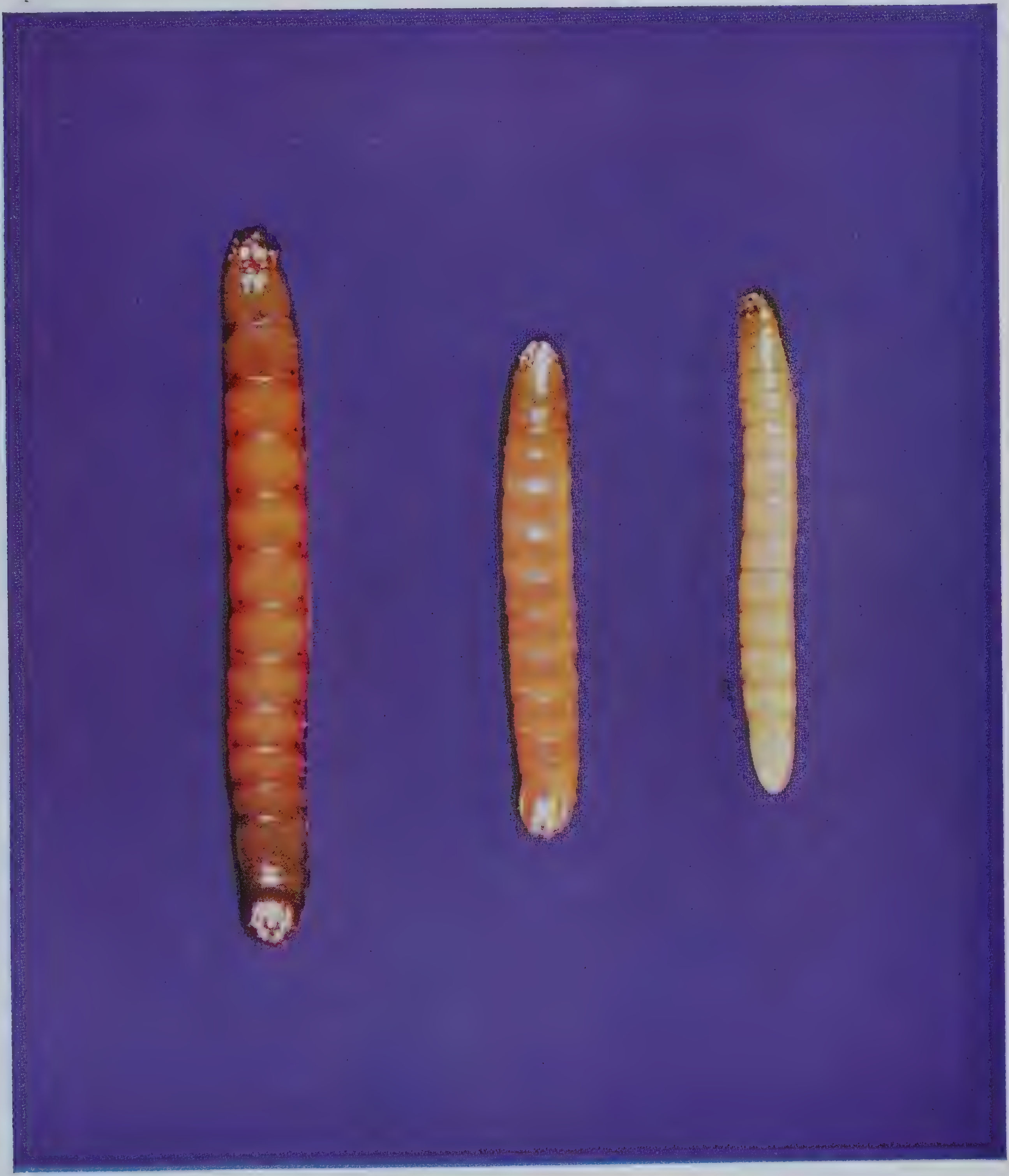
LARVAL STAGE

Wireworms in the first year

Young larvae upon hatching are milky white in color and exceedingly small, measuring 1.5 to 2 millimeters in length. They grow slowly during the first year, attaining a length of from 3.5 to 6 millimeters. This is a noticeable variation in size and occurred even in laboratory-reared populations of the same approximate age. Measurements of first-year wireworms taken from field samples were found to follow the usual distribution curve with an average at approximately 4.5 millimeters.

Wireworms in the second year

During the second year the wireworms grow more rapidly and are particularly injurious at this time. Molting in the field occurred chiefly during two periods, in the spring (May and June), and again in the fall



THE THREE WIREWORMS MOST INJURIOUS TO POTATOES

Left to right: corn wireworm (*Melanotus* sp.); eastern field wireworm (*Limonius ectypus* Say); wheat wireworm (*Agriotes mancus* Say)

(August and September). During the molting periods larvae cease feeding and become quiescent while the new cuticule is forming.

At the end of the second year, variations in larval size are still evident. This is shown from measurements taken on wireworm populations found in two fields on the same farm, one cropped to potatoes and the other in sod. Infestations in both cases started in sod the two years before, and only the second- and third-year wireworms were considered in the measurements. The wireworms found at harvest time in the potato field measured 9 to 20 millimeters in length (figure 9), a spread of 11 millimeters. Most of the larvae were in the larger intervals, 15 millimeters and above. Wireworms in the sod, exclusive of the current season's infestation, varied in size from 6 to 18 millimeters. The greater proportion of the population was between 8 and 13 millimeters. This bit of evidence indicates that some crops influence the growth of wheat wireworms and thus may influence the length of the life cycle. This presents an interesting problem that may be of significance in planning control measures.

Wireworms in the third year

Most of the larval growth, provided conditions are favorable, takes place during the second year. Previous to pupation in the third year, wireworms are 15 to 22 millimeters in length. However, size is not a true criterion of maturity, as judged by the onset of pupation. In both laboratory-reared and field populations only a portion of the third-year wireworms pupated. The remainder required a fourth year of growth before transformation. It is possible that a few individuals may require five years for full larval development.

Hibernation

During the winter months, wireworms hibernate at varying depths in the soil. Although there is a slight migration downward in the soil, many

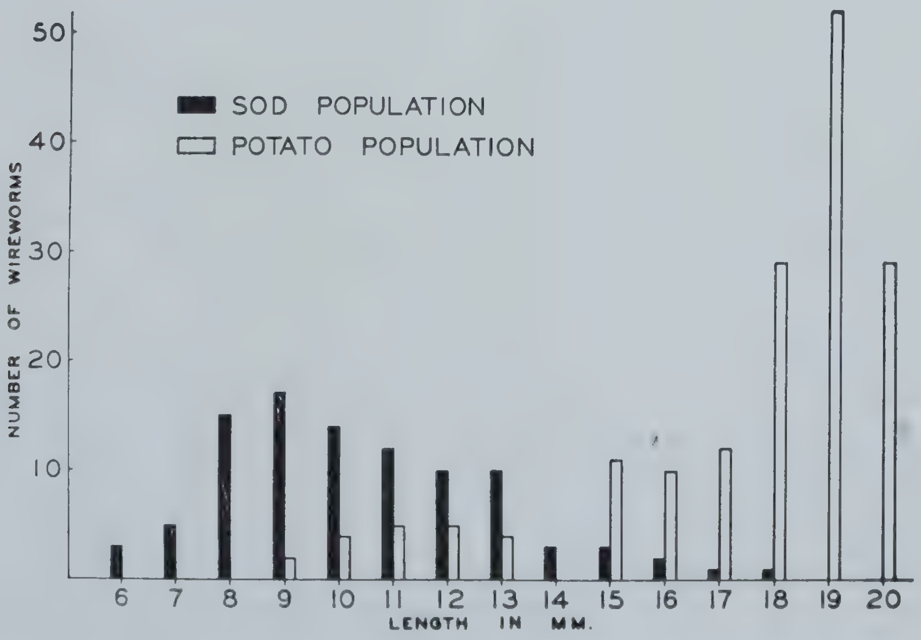


Figure 9. size variations of second- and third-year wireworms from populations in fields planted to clover-timothy sod and to potatoes

of the wireworms remain within the frost zone. In many instances wireworms found in frozen soil revived and appeared normal. Many workers have reported that exposures to extreme cold temperatures will kill wireworms. However, such temperatures are seldom reached during the normal winter even in the frost zone. Early in the spring the wireworms move upwards to feed on available plant roots. When the topsoil is moist, wireworms are often found under stones and surface debris.

Food and food plants

Wireworms are indiscriminate feeders. Their food consists of the underground parts of living plants and, according to many authorities, it also includes humus and small soil-inhabiting animals. The list of food plants is almost an endless one. Injury is particularly severe to sprouting seeds, seedlings, transplants, roots, and tubers. Crops severely injured are usually designated *susceptible*, as distinguished from *immune* crops, which are able to withstand wireworm attacks without loss or damage.

The role of humus as food for wireworms is a controversial question. Some investigators believe that the decaying organic material of the soil is a predominant part of the wireworm diet. In fact the use of farmyard manure and green-manure crops has been suggested as a means of reducing injury, since it was believed that wireworms attack growing plants only in the absence of humus. However, wheat wireworms have caused severe damage to potatoes in soils well supplied with organic matter.

The food of the newly hatched wireworm is composed chiefly of the succulent underground parts of living plants, the roots, stems, and tubers. Although humus is abundant in soils infested by wheat wireworms it is not important in their diet. Newly hatched larvae fail to survive in these soils unless roots of growing plants are available for food. If these newly hatched larvae ingest particles of humus they are either unable to utilize this material as food or the humus does not contain enough food substance to support life.

The older second- and third-year larvae are considerably more resistant to starvation than are newly hatched wireworms. Individuals have remained alive in soil without growing plants for at least two years, but larval growth was apparently static during this time. However, a high mortality occurred during the first year of the starvation period and only a few of the original number remained alive when the experiment was discontinued.

PUPAL STAGE

A few days previous to pupation during the latter part of July and throughout the month of August the mature wireworms cease feeding and construct their pupal cells (figure 10, A). By rolling and twisting movements the larvae form small cavities large enough to accommodate the pupae. The larvae then become quiescent, and within a short time transform to white wax-like pupae which bear a close resemblance to the beetles in size and shape. From this apparently lifeless form the beetles emerge in approximately two weeks. Unless disturbed they do not venture from their pupal cells until the following spring.

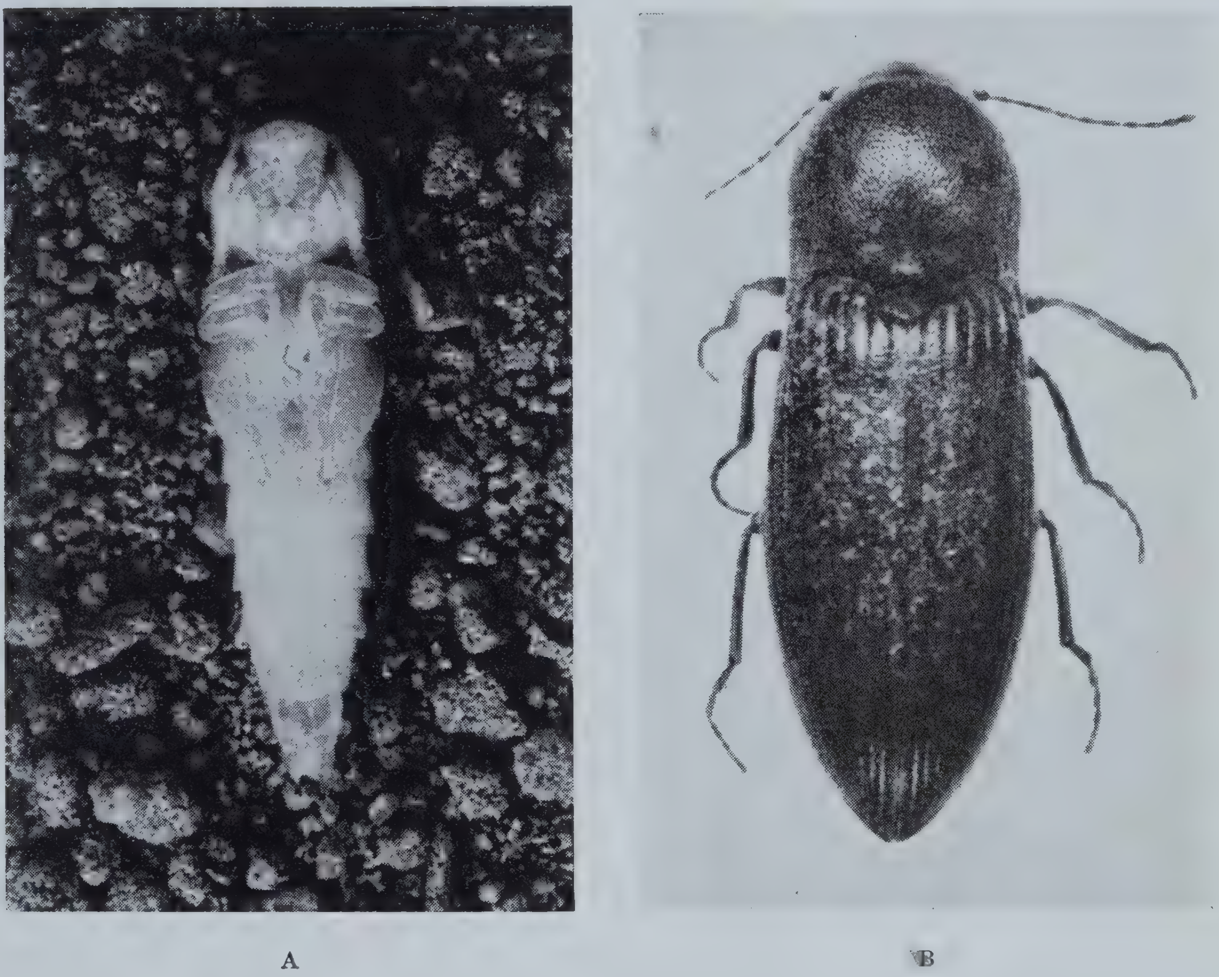


FIGURE 10. PUPAL AND ADULT FORMS OF THE WHEAT WIREWORM
A. Pupa (×4)
B. The dark-brown adult, or click beetle (×6)

ADULT STAGE

The beetles, known as *click beetles*, or *skip jacks*, because of their ability of springing into the air when turned on their backs, leave the pupal cells as soon as the soil warms up in the spring and make their way to the surface during late April and May (figure 10, B). They are not ordinarily noticed in the field unless special efforts are made to collect them. Beetles emerging in cultivated fields hide under stones, soil clods, and other surface objects, where they collect in large numbers especially during the mating season. In sod and grasslands the beetles find shelter in the crowns of the plants and in crevices in the soil. The heavy cover of sod and grass offers so many hiding places for the beetles that they are difficult to find except by sweeping with an insect net.

Migration

Wheat-wireworm beetles are most active during warm days when the temperatures are above 85° F. They are not so active, however, as many other Elaterids. In cultivated fields an occasional individual may be seen during the daytime running from one place of concealment to another. Sometimes they are noticed perched on stones or clumps of soil. Spasmodically they make feeble attempts to take flight.

During warm days of May and June large numbers of the beetles may be conveniently collected from sod and weedy growth in infested fields.

A large proportion of these are males. Upon close examination they are found resting on the stems and foliage of the vegetation. When disturbed they immediately fall to the ground and disappear into the foliage cover. Observations have been made many times of beetles resting on foliage and flowers, but no evidence of feeding has been noted. In cages the beetles chew the cut edges of grass clippings and apparently ingest some of the pulpy material. They also feed voraciously on sugar syrup, molasses, and honey.

On a few occasions wheat-wireworm beetles were noted in flight. The evidence indicates, however, that they are not active fliers and probably migrate very little by flight. Beetles were seldom taken in sweepings on bushes and shrubs along woodlands and fence rows bordering infested fields. Other species of the genera Limonius, Ludius, and Melanotus are common on wild cherry, blackberry, and other shrubs. Beetles captured on tanglefoot traps were chiefly of these species. The traps were constructed of hardware cloth tacked to frames and mounted on posts four to five feet from the ground. Tanglefoot was liberally applied to the wire cloth to make a sticky surface. Beetles flying against the tanglefoot were captured and retained on the screens. The summarized catch records of table 4 indicate that wheat-wireworm beetles are not as active fliers as the other species.

Beetles are extremely susceptible to desiccation and succumb when exposed to long periods of dry air or soil. They are usually found in moist places close to the soil surface. For this reason fields covered with vegetation are more favorable to adult life than are cultivated fields. Many investigators have suggested that the beetles migrate to grasslands for oviposition. Observations by the writer have not intimated such a migration.

TABLE 4. TANGLEFOOT-TRAP RECORDS OF ELATERID BEETLES CAPTURED IN 1934 AND 1935

Number of trap	Crop in field in which trap was located	Numbers of *Agriotes mancus* beetles captured	Numbers of other species captured
1	Sod	0	2
2	Sod	0	14
3	Sod	5	65
4	Oats	3	7
5	Potatoes	0	45
6	Potatoes	0	11
Total		8	144

The attractiveness of moisture and places of concealment provided a means of collecting beetles in fields frequently tilled by harrow or cultivator. Baits similar to those suggested by Comstock and Slingerland (1891) were used. These baits consisted simply of a handful of grass or weeds placed on moist soil and covered with a shingle. During the night the beetles, attracted by the baits, congregated in the foliage and were collected the following day. This method of collecting beetles works very well for cultivated fields but is ineffective in sod and grasslands.

Beetles were present in large numbers on cultivated fields during the egg-laying period as long as moisture conditions were favorable. A thorough survey of two fields by the use of baits showed that beetles did not migrate from infested areas to those uninfested. As mentioned before, infestations of wheat wireworms are spotted. They occur chiefly in the low portions of the field. The collection data for the two fields show that the beetles do not migrate from the low areas of the fields to the knolls, which are relatively free of wireworms.

This is not surprising since beetles migrate chiefly by running over the soil surface. The distances traversed are therefore limited. This is brought out in an experiment designed to obtain further information on beetle migration. A large number of marked beetles were released on a cultivated field and allowed to disperse. Daily bait catches were examined for marked beetles during the period of beetle activity. More than half of the beetles released were again captured in the numerous baits surrounding the point of release. The longest recorded distance traveled by the beetles was about eleven yards.

Bait records taken in three fields during the years of 1934 and 1935 shed some light on beetle activity. The spring of 1934 was marked by a shortage of rainfall, whereas precipitation was more plentiful in 1935.

In 1934 the topsoil surface dried out quickly, especially after cultivation. When the soil had dried out, unfavorable conditions prevailed and the beetles disappeared. After the start of egg-laying in the laboratory (table 5) on June 10, only one beetle was captured in the traps. Dead beetles which had apparently succumbed from desiccation were found under stones and under the piles of dried grass thrown aside after use in the baits. This would explain the absence of beetles in the baits after June 5, at which time the topsoil was very dry.

TABLE 5. BAIT-TRAP RECORDS OF WHEAT-WIREWORM BEETLES IN A CULTIVATED FIELD, 1934

Date of baiting	Number of beetles	Observations
May 28	146	Soil moist; beetles under stones and lumps of soil
May 30	122	Same as above
June 2	176	Field harrowed; soil drying out
June 5	34	Soil very dry
June 10	...	Egg-laying began in laboratory
June 13	1	Potatoes planted; topsoil very dry
June 27	0	Plants above ground; weeded

In the spring of 1935 rains were frequent and the seasonal rainfall was normal. The soil surface did not dry out so thoroughly as in the previous year, even with a number of cultivations. Beetles were collected in traps throughout June after egg-laying had started (table 6). Dissection of female beetles at each collection indicated that they had laid nearly all of their eggs at that time. In this instance, at least, migration of beetles to grasslands for oviposition was not substantiated.

Oviposition

Eggs are deposited in the soil either singly or in groups. In laboratory cages, the females place their eggs in cracks and crevices of the soil and under surface objects. No attempts are made by the beetles to burrow

TABLE 6. BAIT-TRAP RECORDS OF WHEAT-WIREWORM BEETLES IN TWO CULTIVATED FIELDS, 1935

Date of baiting	Number of beetles	Observations
Field 1		
May 28	163	Soil moist
June 7	189	Soil drying out slightly; egg-laying started June 6 in laboratory
June 13	201	Same as above
June 14	701	Soil moist
June 30	21	Soil moist
July 5	8	Soil moist
Field 2		
May 29	16	Oats planted in this field; soil moist
June 4	94	Soil moist; egg-laying started June 6 in laboratory
June 11	24	Soil moist throughout the baiting period
June 22	12	
June 29	12	
July 1	6	

deeply into the soil as do some other Elaterids. The eggs are usually deposited in the upper one-half inch of soil.

The number of eggs laid by single female beetles varies considerably under laboratory conditions. For ten individuals, the maximum number laid was 176 and the minimum number was 48. The average number was 104.9. Considerable difficulty was experienced in obtaining data on egg-laying because most of the female beetles died before laying all of their eggs. Beetles collected early in the spring did not oviposit unless fed on sugar solutions. Food appeared to be necessary during the oviposition period. However, the food requirements for the beetles is incompletely known at the present writing.

SUMMARY

The story of the life history is graphically indicated in figure 11. Beetles of the wheat wireworm leave their pupal cells early in the spring and appear on the soil surface during a period from May to late July. Eggs hatch in approximately three weeks. The young wireworms grow very slowly the first year, barely measuring a quarter of an inch in length by fall. Growth is most rapid during the second year. Some of the wireworms reach maturity and pupate during the third year of the life cycle. The remaining larvae transform to pupae the following year. Pupation occurs in late July and August. The final transformation to the beetle stage two weeks after the start of pupation completes the life cycle. The interval of time between the appearance of generations is three to four years.

CONTROL MEASURES FOR THE WHEAT WIREWORM

The efforts of entomologists have been directed towards efficient and practical methods of wireworm control since the beginnings of applied entomology. In a comprehensive review, Thomas (1930) briefly summarized the present knowledge of wireworm control, as included in more than two hundred references contributed from all parts of the world. A survey of this mass of literature reveals a wide diversity of ideas and considerable conflicting opinion. This is not surprising since the practical success of any control measure depends upon a complexity of factors which differ with wireworm species, crops, climates, and agricultural practices.

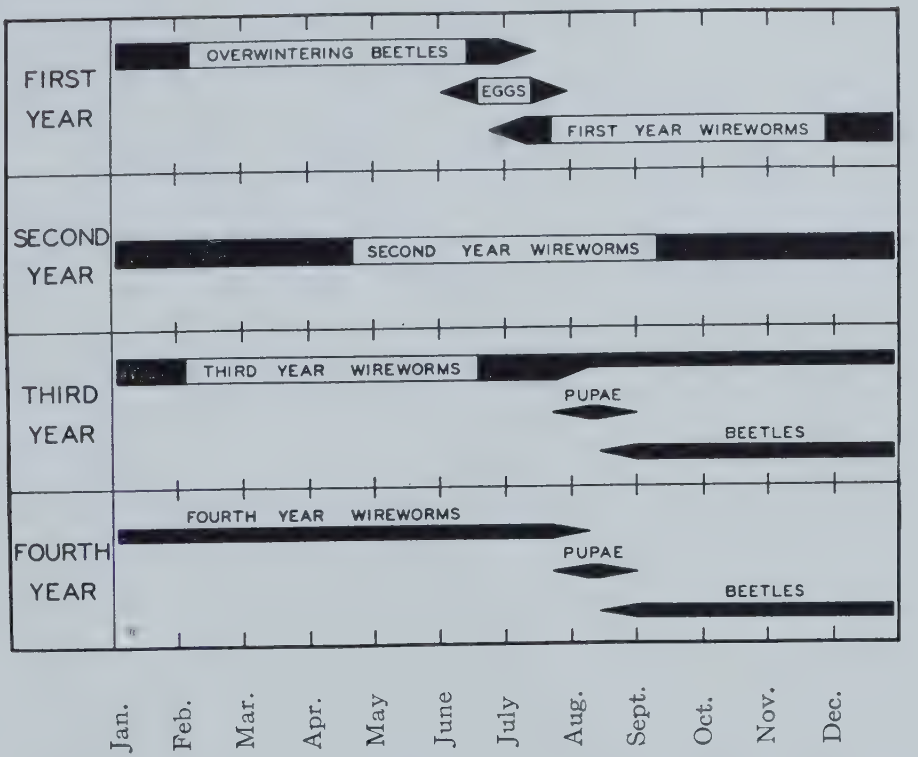


Figure 11. LIFE HISTORY OF THE WHEAT WIREWORM

Measures recommended and employed for the control of wireworms are as varied as they are numerous. Such methods employ the use of (a) soil fumigants and sterilizers, (b) seed protectants and repellents, (c) and cultural practices. Soil fumigants and sterilizers such as cyanides, chloropicrin, dichloroethyl ether, and others are injected into or mixed with infested soil. The toxic gases released rid the soil of the wireworms and other noxious organisms. Soil fumigation should be extremely practical because it would lend itself to most conditions and most of the soil fumigants have been found effective and useful. However, fumigating the soil is not practical for potato growers in New York and is therefore not recommended. Some of the objections to soil fumigants are their cost, mechanical difficulties in application, and toxicity to the crop.

Seed treatments with poisons and repellents have not proved of any value. Many of these materials quickly lose their repellency before the sprouts develop resistance to wireworm attack. The protection of the potato seed piece does not protect the developing tubers after the mother tuber has disappeared from decay. Very few substances used as seed treatments are either repellent or toxic to wireworms.

CULTURAL AND ROTATIONAL PRACTICES

Cultural and rotational practices are among the oldest and most commonly recommended methods for control of the wheat wireworm. Some of these practices are extremely effective in reducing damage and are practical because they can be fitted into the general farming systems. Wireworm control through proper revision of the potato rotations is being effectively used by growers.

The abundance of wheat wireworms in grasslands and long-standing sod crops has been often noted by investigators and potato growers. As early as 1867, Fitch (1867) in his eleventh entomological report stated that "it may be received as an axiom that wherever grass will grow the wireworms may be found for the roots of the various species all afford sufficient nourishment for their support." He then recommended that farmers follow meadows or sod with at least three years of cultivated crops before planting corn or potatoes. Many other workers since that time have suggested that the best method of control for the wheat wireworm is continued cultivation of infested fields.

One of the common potato rotations in New York, particularly in dairy-farming regions, includes three crops, sod (clover and timothy), potatoes, and spring grain. This rotation cycle requires three to four years for completion. Although the progression and kinds of crops vary from farm to farm, potatoes usually follow sod or hay crops. This system is well adapted to dairy-farming and is commonly used by the growers with small acreages. On the large potato farms potatoes are planted continuously or rotated with green-manure soil-building crops. Long-standing and forage crops are not included in these short, more intensive rotations.

In the study of the relation of rotations to wireworm infestation it was necessary throughout the work to obtain representative populations present in each crop of the rotation system. Hence a large number of soil samples were examined for wireworms. The soil was sifted through several screens to facilitate collection of even the smallest individuals. Although this method was slow and laborious, it was found most effective for the field conditions in western New York. At the time of sampling in September and October the wireworms were usually in the upper eight inches of soil. After the wireworms were collected, they were measured and placed in the following classes: first year (3 to 6 millimeters in length), second year (7 to 15 millimeters), and third year (more than 16 millimeters). While larval length is not a positive criterion of age, this system of measurement was sufficiently accurate to meet the needs of field work.

At the outset of the investigations a number of farms were selected for the study of relation of farm crops and rotations to infestation. Through cooperation with the owners, changes in cropping systems and sequence of crops were made when necessary for observation and detailed study. The area of the fields was from 5 to 20 acres, and according to the growers had been infested with wheat wireworms for many years.

FIELD CROPS AND WHEAT-WIREWORM INFESTATIONS

The results of the preliminary field studies show a very definite relation between the crop and the incidence of infestation. In summarizing the data in table 7, the crops surveyed for wireworms are placed in sequence as they occur in the rotation. The first-year larvae occur almost exclusively in sod. Sod crops remaining for a second year are again infested during the second season. Wireworm infestations did not start in either potatoes or spring grain, since these crops are comparatively free of first-year larvae. The larval population in potatoes following sod consists predominantly of second- and third-year wireworms. A year later in the spring-grain crop most of the wireworms in the population are either in the large-size group or have matured and transformed to beetles. The appearance of beetles the next spring will then coincide with the hay crop seeded in the spring grain. In these rotations, sod appears as a crop every third year (3-year rotation), or third and fourth year (4-year rotation). With the completion of the wireworm life cycle in three to four years, potato rotations which include sod every third and fourth year are continuously reinfested.

TABLE 7. RELATION OF THE COMMON ROTATION SYSTEMS IN WYOMING COUNTY TO WIREWORM POPULATION AND SIZE OF WIREWORMS

Year	Crop	Total population	Beetles	Third-year larvae	Second-year larvae	First-year larvae
1930	Sod					
1931	Potatoes					
1932	Grain					
1933	Sod	465	43	59	14	349
1930	Potatoes					
1931	Grain					
1932	Sod					
1933	Potatoes	1025	22	625	371	7
1930	Grain					
1931	Sod					
1932	Potatoes					
1933	Grain	733	233	437	63	0
1930	Potatoes					
1931	Grain					
1932	Sod					
1933	Sod	542	9	26	245	262

SUSCEPTIBILITY OF CULTIVATED AND SOD PLOTS TO INFESTATION

The relative susceptibility of cultivated and sod fields to infestation is shown from a series of small-plot experiments. Small areas in six sod fields were plowed, fitted, and planted to crops such as potatoes, beans, and grain, referred to as *cultivated crops*. These plots alternated with sod plots of the same size and were replicated. In the fall representative soil samples were examined, and wireworms measuring 3 to 6 millimeters were recorded and considered as first-year larvae. A striking contrast of populations in the sod and cultivated plots may be noted from table 8. The number of first-year wireworms in the sod plots was many times the populations in corresponding cultivated plots.

TABLE 8. A COMPARISON OF FIRST-YEAR-WIREWORM POPULATIONS IN SMALL PLOTS PLANTED TO SOD AND CULTIVATED CROPS

Field	Crop	Number of replications	Number of samples	Number of first-year larvae	Population per acre
1	Sod	4	29	139	52,272
	Cultivated	4	29	1	376
2	Sod	3	18	65	39,204
	Cultivated	3	18	0	0
3	Sod	4	20	109	60,984
	Cultivated	4	20	3	1,612
4	Sod	2	20	182	100,188
	Cultivated	2	20	2	1,089
5	Sod	2	26	91	50,529
	Cultivated	2	13	0	0
6	Sod	2	12	234	284,447
	Cultivated	2	8	14	25,700

As is sometimes the case, it is possible that these small-plot experiments did not give a true picture of what would happen under average field conditions. As mentioned previously, beetles migrate short distances by crawling over the soil surface. Beetles emerging on the small cultivated plots probably moved to more attractive shelter in the sod plots. In large areas the beetles remained on the fields during the egg-laying period as was the case in the spring of 1935. There was then a question of reinfestation in these fields in which sod had been eliminated from the rotation.

MODIFICATION OF THE POTATO ROTATIONS

Reduction in wireworm population

It is therefore of interest to trace the trends of wireworm populations in fields with modified rotations. Four severely infested potato fields were subsequently cropped continuously with potatoes or spring grain. One heavily infested area in each field was sampled for a number of years following the heavily populated sod. Different but comparable sampling methods were used in the two crops to allow for differences in the distribution of the larvae in grain and hill crops. The census figures summarized in table 9 show rapid decreases in wireworm populations following modification of the rotation by continuously planting either potatoes or spring grain. After three years from the sod crop, the wireworm population had practically disappeared. These fields were not reinfested by new generations of wireworms. Normally reinfestation takes place every third and fourth year coincident with the sod crop.

TABLE 9. CULTIVATION OF INFESTED FIELDS AS AFFECTING THE WIREWORM POPULATIONS AND REINFESTATION OF THOSE FIELDS

Field	Year	Crop	Number of samples	Number of beetles	Number of mature and second-year larvae	Number of first-year larvae
1....................	1929	Sod				
	1930	Potatoes	13	1	119	0
	1931	Potatoes	13	19	83	0
	1932	Grain	13	10	17	0
	1933	Potatoes	13	0	3	0
2....................	1930	Sod	13			
	1931	Potatoes	13	1	88	0
	1932	Potatoes	13	42	23	0
	1933	Potatoes	13	6	9	1
	1934	Potatoes	13	2	3	0
	1935	Potatoes	13	0	1	0
3....................	1931	Sod	20			
	1932	Potatoes	20	. .	96	0
	1933	Potatoes	20	. .	35	0
	1934	Potatoes	20	. .	6	0
	1935	Potatoes	20	. .	2	0
4....................	1929	Sod	13			
	1930	Potatoes	13	0	121	0
	1931	Grain	13	33	88	0
	1932	Potatoes	13	18	9	0
	1933	Grain	13	0	2	2

Reduction in wireworm injury to potatoes

A decline in the wireworm populations following the elimination of sod from the potato rotation is correspondingly reflected in the injury. The heavy infestations of wireworms which had originated in the sod crop caused severe injury to the first crop of potatoes. Injury decreased sharply thereafter and became practically nil after three years of cultivated crops, as indicated in table 10.

TABLE 10. REDUCTION OF WIREWORM INJURIES TO POTATO TUBERS FOLLOWING ELIMINATION OF SOD FROM THE ROTATION

Field	Year	Crop	Per cent of injury to potato tubers
1	1929	Sod	
	1930	Potatoes	92.0
	1931	Potatoes	17.7
	1932	Grain	......
	1933	Potatoes	0.04
2	1930	Sod	
	1931	Potatoes	85.0
	1932	Potatoes	4.0
	1933	Potatoes	0.75
	1934	Potatoes	1.7
3	1931	Sod	
	1932	Potatoes	77.7
	1933	Potatoes	57.1
	1934	Potatoes	2.8
	1935	Potatoes	2.04
4	1929	Sod	
	1930	Potatoes	100.0
	1931	Grain	......
	1932	Potatoes	10.4
	1933	Grain	......

Present rotation projects

The studies on the relation of rotation to wireworm injury has been expanded to include other insects, diseases, yields, and other phases of potato-growing. The Departments of Vegetable Crops, Plant Pathology, and Agronomy, at Cornell University, are cooperating in these projects, started in 1936 and located in three widely separated areas of the State. One plot field is near Malone in northern New York, another in Genesee County, and the third in Steuben County.

Nine different rotation systems are being compared in each plot field. Each experiment includes a large number of small plots covering approximately four acres. An airplane view of the plots in Steuben County is shown in figure 12.

Heavy infestations of wheat wireworms are present in two of the experiments. Results of tuber injury to date confirm the previous work as reported in this bulletin. Infestations start in the clover-timothy plots and potatoes planted in these plots are severely injured. The short rotations that do not include sod have not been susceptible to infestation and the amount of wireworm damage has been low as compared with the injury in long rotations.

NATURAL ENEMIES OF THE WHEAT WIREWORM

The efficiency of natural enemies in reducing wireworm infestation is difficult to evaluate under field conditions. Wireworms in their subterranean habitat are not only admirably protected from their enemies but are also concealed from observation. It is therefore difficult to determine the agencies responsible for natural reduction under field conditions.

Wireworms are, however, subject to destruction from parasites and predators. Birds and predacious insects prey on all stages of Elaterids, particularly the beetles during the flight period. Parasitism is commonly reported in the beetles. Disease is troublesome in rearing cages, sometimes destroying entire populations. Several fungi have been isolated

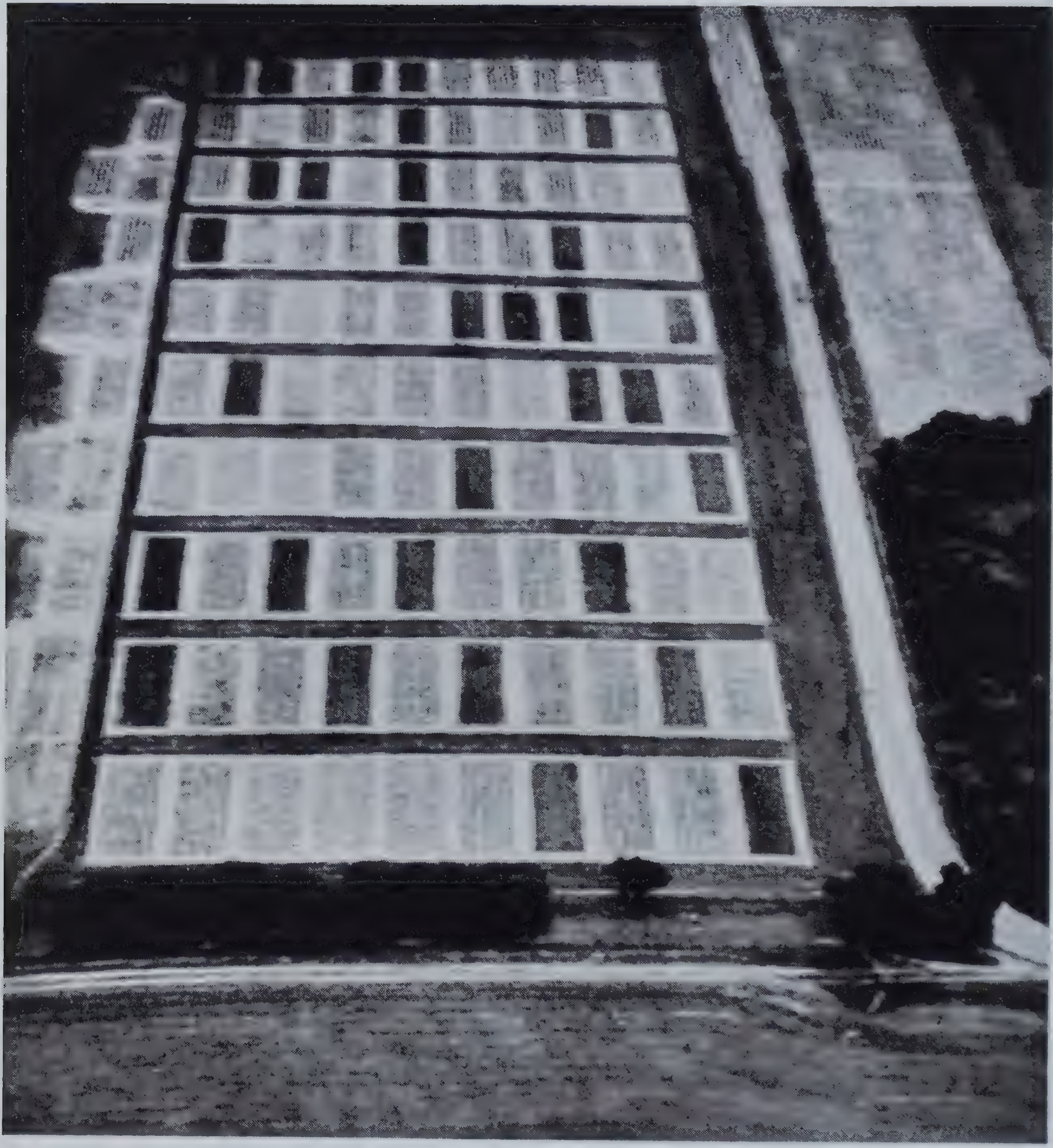


FIGURE 12. AERIAL VIEW OF THE POTATO-ROTATION TRIALS ON THE FARM OF C. D. WOLCOTT AND SON, COHOCTON, NEW YORK

The experimental plots cover an area of approximately four acres

from diseased specimens but apparently the pathogenicity of these fungi has not been thoroughly established.

In analyzing the data accumulated from the yearly wireworm census of a number of fields, an unaccountable reduction was noted in populations from year to year. Referring to table 11, if no mortality occurred during a year, the total population, beetles and larvae, would closely approximate the larval population of the previous year. For instance, in field 1 the total population (65) of the second-year crop of potatoes was 23 less than the number of larvae recorded in similar samples of the previous year. Similar reductions of 10 to 75 per cent were noted in six of seven cases, and indicate that considerable natural mortality occurs from year to year.

TABLE 11. REDUCTIONS OF WIREWORM POPULATIONS BY NATURAL FACTORS UNDER FIELD CONDITIONS

Field	Crop	Number of samples	Number of beetles	Number of larvae	Reduction of population	
					Number	Per cent
1	Sod					
	Potatoes	13		88		
	Potatoes	13	42	23	23	26.14
	Potatoes	13	6	9	8	34.78
2	Sod					
	Potatoes	13		119		
	Potatoes	13	19	83	17	14.29
	Potatoes	13	10	17	56	67.47
3	Sod					
	Potatoes	13		121		
	Grain	13	33	88	0	0.0
	Potatoes	13	18	9	61	69.32
4	Sod					
	Potatoes	15		214		
	Potatoes	15	18	36	160	74.77

Although sampling errors may have been considerable, the magnitude of the decreases is such that sampling variations probably do not account for the reductions. The natural agencies responsible for the observed decreases are not known since dead larvae were seldom found in the field. Natural mortality is generally considered to be only partially effective in wireworm control, and artificial methods have to be used to reduce populations.

SUMMARY

The importance of the potato-tuber-defect problem in upstate New York is indicated from field surveys made during 1931 and 1932. These surveys show that more than one-half of all the tubers examined were injured by insects, diseases, and the mechanical operations of harvest. Wireworm injury was one of the most important of the defects.

Three species of wireworms are commonly found in potato fields. Of these three, the wheat wireworm (*Agriotes mancus* Say) is the most abundant and injurious. The other two species, the eastern field wireworm (*Limonius ectypus* Say), and the corn wireworm (*Melanotus* sp.), while not as widespread as the wheat wireworm, are nevertheless injurious in many potato-producing areas.

All portions of the potato plant, seed piece, stems, stolons, and tubers are subject to injury. Tuber damage as it affects the market quality of the crop is of chief concern to the grower. Wireworms burrow into the tuber flesh, leaving tunnels which cause excessive waste when injured potatoes are prepared for the table. There are a number of variations of wireworm injury caused by growth of the tuber after injury or invasion by soil organisms into the tunnels.

A study of the biology and control of the wheat wireworm was made during a six-year period from 1930 to 1936. The life cycle is three to four years in length. Eggs are laid in the soil from June to July and hatch in approximately three weeks. The wireworms grow slowly to larval maturity in two to three years. Pupation then occurs from late July through

August and concludes with the appearance of the beetles, which remain in their pupal cells over the winter.

Infestations of wheat wireworms start in grass and sod crops. Potatoes, corn, and similar crops are not subject to new infestations. The common potato rotation in upstate New York includes a sod crop every third and fourth year. Potatoes generally follow the sod. The appearance of the beetles during the third and fourth years of the life cycle occurs simultaneously with the sod crop in the rotation. Potato crops in this rotation are therefore usually infested.

Marked reductions in wireworm populations and in resultant damage to potatoes followed elimination of the sod crop from the potato rotation. Continuous use of cultivated crops on infested fields reduced wireworm injury to a minimum after three years. The control of wheat wireworms by short rotations is not due to mechanical action of cultivation but rather to unfavorable conditions for oviposition and survival of the young larvae in cultivated crops. Such short rotations should include crops that can be tilled during the egg-laying period during June and July.

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The Incubation Test as an Indication of the Keeping Quality of Butter

H. B. Naylor and E. S. Guthrie

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THE INCUBATION TEST AS AN INDICATION OF THE KEEPING QUALITY OF BUTTER

H. B. Naylor and E. S. Guthrie

In recent years, the use of the incubation test for predicting the keeping quality of butter has become widespread in the butter industry. The test is relatively easy to apply; it is inexpensive since it involves very little equipment and time, and it yields results quickly. The industry, therefore, is depending more and more on this test, either alone or in combination with other routine analyses, to predict what will happen to the flavor of a given lot of butter in storage, in trade channels and in the home of the consumer.

Since the incubation test holds such a prominent place among the methods of controlling butter quality at the present time, a further study of the test seemed appropriate. Consequently, this work was undertaken, not with the hope of solving the problem of keeping quality of butter, but with the desire that something might be added to what is already known.

HISTORY OF THE TEST

According to Nelson (1932), Bouska, as early as 1913, used an incubation test similar to the one in use at the present time. He placed two-ounce samples of butter in screw-capped glass jars and incubated them at 15.5°C. for two weeks. Before adopting that temperature, he tried holding the samples at 2° C. but found that this temperature was too low, since the changes that occurred were not comparable with those occurring in channels of distribution.

In 1921, Bouska and Brown reported the use of a rapid test for keeping quality of butter. They suggested that temperatures ranging from 15.5° C. to 21° C. be used in incubating small samples of butter for two weeks. Butter with poor keeping quality developed a bad flavor within three days, while butter with good keeping quality did not develop a bad flavor in two weeks with this test.

A somewhat related test was reported by Sutton (1929). His "bottle test" consisted of placing small amounts of butter in sterile flasks, melting the butter, and allowing it to stand at room temperature for 7 days. He found that this test gave results which confirmed and supplemented results obtained by the plate-count method, and was particularly valuable for the detection of "decomposed" odors. He also concluded that odors due to changes in the sugar and protein fractions of butter are a more reliable indication of biological activity than those which originate from changes in the milkfat.

Another modification of the incubation test was described by Minster (1932). In Minster's work, the butter was held for 4 days at 37°–38° C. and was observed daily for the development of odors. This test was used in conjunction with catalase, reductase, and bacteriological tests. It was found that all four tests when considered together gave a reliable indication of keeping quality, but that the incubation test alone could not be relied upon.

In some work reported by Bendixon, Prouty, and Ellington (1937), it was found that the odor which developed in 67 samples of butter incubated at 21° C. for one week gave little indication of the keeping quality of the same butter stored for one month at 0.5° C. They found that complete flavor scores of butter held in sterile bottles for one week at 21° C. did not check in every case with the stored samples. They stated that the test seemed to be of some value when the butter scored 35 or more in flavor when fresh. Their flavor scores on the incubated butter of this type checked within 0.5 of a point with the flavor scores of the stored butter in 71.4 per cent of the samples.

From his studies of the incubation times and temperatures in relationship to flavor deterioration of butter, Jacobsen (1937) concluded that flavor deterioration in unsalted butter within 7 or 10 days at 21° C. indicated flavor deterioration within 56 days at either 5 or 0° C. However, if the flavor remained unchanged after 7 to 10 days at 21° C., it did not necessarily insure good keeping quality at the lower temperatures. He found that the flavor deterioration of unsalted butter at 15° C. compared more closely with flavor deterioration at lower temperatures than did the results at 21° C., but that a longer period of incubation had to be employed.

Much of the data on the reliability of the incubation test have been collected by commercial butter concerns. Millions of samples of butter have been put through the test, but only a few of the results have been published. Parsons (1938), of the chemical laboratory of Swift and Company, reported that over a period of six years, during which time many thousands of samples of butter were subjected to the incubation test, it was found that holding butter for 14 days at 60° F. gave excellent information regarding the keeping quality and outstanding flavor defects of the butter. The results obtained by holding the butter for 7 days at 68° to 70° F. were similar but not so informative.

Parsons (1939) later reported a summary of results obtained from about 800,000 tests on butter judged for quality before and after incubating for 7 days at 70° F., and about 200,000 tests on butter held for 14 days at 60° F. He states that fairly reliable information as to what will happen to butter handled under average merchandising conditions can be obtained by comparing the scores when butter is carefully scored before and after incubation at 60° F. for 14 days. Butter which had been properly manufactured showed very little loss in score, while butter which had a tendency to deteriorate in trade channels showed about the same deterioration with this test. When the test employing 70° F. for 7 days was used, practically all of the flavor defects of the butter showed up, with the exception of limburger and surface taints. Parsons states that the indications are that butter held 14 days at 60° F. compares favorably with butter held 10 days at 65° to 68° F., and recommends that the latter test be used when trying to detect limburger and surface taints.

SOURCE OF BUTTER

The butter used in this work came from two general sources. A set of ten churnings was made in the butter laboratory of Cornell University by the senior author. The remainder of the samples were obtained from four commercial creameries in New York State.

The butter made in the laboratory was of high quality. Every precaution was taken to insure the best possible keeping quality in the light of what is known about the factors involved. Fresh milk from the Cornell dairy herd was separated with a thoroughly washed and scalded separator. The cream was standardized to 30 per cent fat and immediately pasteurized at 165° F. for 30 minutes. The pasteurization was carried out in a shotgun can immersed in hot water. The can was covered with a metal cover having a small hole in the top just large enough to allow the handle of a stirring rod to pass through. A can of skimmilk was placed in the water bath beside the can of cream and was used for checking the temperature, because the insertion of a thermometer in the cream offered too much opportunity for contamination. Both cans were stirred slowly throughout the pasteurizing process to insure uniform heating.

The high-temperature, holding method of pasteurization was used because several workers (Bendixon and associates, 1937; Guthrie and associates, 1936; Hunziker and associates, 1917; Larsen and associates, 1916; and Wiley, 1939) have reported that butter made from cream pasteurized in this manner, or in a way comparable, has better keeping quality than has butter made from cream pasteurized at lower temperatures. The reason for this has not been found as yet, but it is probably the inactivation of some enzymes which are not inactivated at lower temperatures. Palmer and Combs (1919) found that high-temperature pasteurization retarded the development of tallowiness in butter contaminated with metallic salts, and believed it to be due to the inactivation of natural oxidases present in milk. Palmer and Miller (1926) found that the enhanced keeping quality of butter made from cream pasteurized at high temperatures was not due to the inactivation of peroxidase. Rogers, et al (1912) found that flash pasteurization at temperatures below 150° F. left some factor in the cream which caused a deterioration of the butter. This was not the case when temperatures of 160° F. or higher were used. They also found that, of the common enzymes present in milk, peroxidase was destroyed at 170° F., catalase and lipase at 158° F., and galactase was much weakened between 160° F. and 170° F. but was not completely destroyed even at 200° F. by the flash method of pasteurization. It seems probable that the improvement in keeping quality due to high-temperature pasteurization can be attributed to the inactivation of natural milk enzymes, and perhaps also to the more efficient destruction of microorganisms.

After pasteurization, the cream was cooled immediately to 50° to 55° F. in a water bath. The cooled cream was placed in Dazey churns which had been previously steamed for an hour. The dashers were inserted and the churns were placed in a refrigerator at about 48° F., where they were held over night. The following morning the churns were placed in a water bath at 60° F. and the cream was tempered in this manner for one hour before churning.

After churning, the butter was drained and washed twice. The working was done with wooden ladles on an aluminum working board. Each churning was divided into two portions, salt being added to only half of the butter in each case. Less than one per cent of salt was added in the first two churnings, while the last eight were salted at the rate of 1.5 per cent. A moderate rate of salting was used since the trend in commercial butter seems to be toward mildly salted butter. This trend may be due in part to an increased demand for this type of butter by consumers, but there is some evidence that mildly salted butter has better keeping qualities than has heavily salted butter. Gray and McKay (1906) found that butter containing a low percentage of salt kept better than did butter of the same lot containing a high percentage of salt. It was found by Parsons (1939) that, other things being equal, when the salt content of butter exceeded 2 per cent, there was a tendency for an increasing loss in score.

After the butter was thoroughly worked, four three-ounce, screw-top sample jars were packed with salted butter and four with unsalted butter. The jars, as well as the wooden spatulas used in packing, were previously sterilized by autoclaving. Throughout the making process, every precaution was taken to keep contamination at a minimum.

The samples obtained from commercial plants were taken directly from the churn by men at the plants. Four samples were taken from each churning before salting, and four were taken after salting. All sample jars and spatulas were sterilized before they were sent to the creameries, and careful instructions as to how the samples should be taken were sent to the men in charge of these plants. All samples were sent to the butter laboratory of Cornell University the same day that they were taken. One plant packed with dry ice and one packed with ordinary ice. These samples were sent by express. The other two creameries were near enough to the university so that the samples could be delivered directly.

PROCEDURE

Of the eight samples taken from each churning, one sample of salted butter was analyzed for moisture, salt, total bacteria, caseolytic bacteria, pH, and flavor; the same tests, with the exception of moisture and salt, were made on one sample of the unsalted butter. Two samples each of salted and unsalted butter were placed in an incubator thermostatically controlled to maintain a temperature of 60° F. ± 1°. One pair of these samples was removed at the end of 7 days, and the other pair was incubated for 14 days. The above tests, with the exception of salt and moisture, were made at the end of the 7-day and 14-day periods. The fourth pair of samples was placed in a refrigerator at 0° F., where it was held for approximately three months. There was some variation in the length of time that samples were stored at the low temperature. The first few samples to be removed from cold storage were scored for flavor, plated for total and caseolytic bacterial counts, and the pH was determined. However, after finding that the bacterial counts had not changed appreciably during storage, the procedure was altered slightly for the remaining samples. Instead of using the entire sample, only enough butter was removed from the jar for a flavor score and pH determination. The remainder of the sample was incubated for 10 days at 60° F. and then scored again. A bacterial analysis and pH determination was also made at that time.

METHODS USED

Moisture determinations were made by the Kohmann method. The method suggested by Mojonnier and Troy (1922) was used for determining salt content. The bacterial analyses were made by placing the sample jars in water at 113° F. until the butter was melted. After thoroughly mixing the sample, dilutions were made by using sterile pipettes and water blanks which were warmed to 113° F. before using. All plates were poured with a medium of the following composition:

0.5 per cent beef extract
0.5 per cent yeast extract
0.5 per cent peptone
0.5 per cent glucose
5.0 per cent skimmilk
1.5 per cent agar
Distilled water
pH 7.0

The plates were incubated for 7 days at 68° F. Total counts and caseolytic counts were made on all plates where it was possible to do so. Caseolytic colonies could be detected by the presence of cleared zones in the otherwise turbid medium. Well-isolated representative colonies of this type were placed in litmus milk tubes or were streaked directly on agar slants of the same composition as that of the agar used for plating. These cultures were incubated at 20° C. until their ability to digest casein was confirmed. Eventually, all cultures isolated were streaked on agar slants and Gram stains were made to determine the general type of bacteria involved.

The pH determinations were made by means of a quinhydrone electrode in connection with a saturated calomel half-cell. Fat-free serum was obtained by centrifuging the melted butter in separatory funnels for a short time. The serum was drawn off carefully to prevent mixing with the fat. By placing the serum in a refrigerator for a short time, any remaining fat floated to the surface and solidified. It could then be easily removed. After warming the samples to room temperature again, pH determinations were made.

All flavor-scoring was done by the authors. Samples were removed from the jars by means of sterile wooden spatulas and were scored immediately.

EXPERIMENTAL RESULTS AND DISCUSSION

BUTTER MADE IN THE LABORATORY

Since very little about the accuracy of the incubation test with respect to high-grade butter has been reported in the literature, the work reported here seems appropriate. Because of the limited time available for this study and the fact that it was impossible to obtain the desired type of samples from commercial creameries, it was impossible to study a large number of churnings. Instead, ten churnings of butter were made in the laboratory. Every precaution was taken to minimize all of the factors known at the present time which cause the deterioration of butter, and each churning was carefully studied.

A summary of flavor scores, criticisms, and pH values is given in table 1.

Flavor changes

As is shown in table 1, with the exception of the first churning, all of the fresh butter had an exceptionally good flavor. The slightly cooked flavor due to the high temperature of pasteurization was overlooked since it was not particularly objectionable and always disappeared after a few days.

TABLE 1. BUTTER MADE FROM SWEET, UNRIPENED CREAM, PASTEURIZED AT 165°F. FOR 30 MINUTES
(Flavor scores, criticisms, and pH values)

Churning no.		Fresh butter			Stored 7 days at 60° F.			Stored 14 days at 60° F.			Stored 113–140 days at 0° F.			Stored 113–140 days at 0° F. +10 days at 60° F.		
		Score	Flavor criticism	pH	Score	Flavor criticism	pH	Score	Flavor criticism	pH	Score	Flavor criticism	pH	Score	Flavor criticism	pH
1	U*	37	Slightly off	6.60	37	Slightly old	6.65	36	Old	6.75	37.5	Slightly metallic	6.85	38	....	6.75
	S*	37	Slightly off	6.40	37	Slightly old	6.40	37	Slightly old	6.40	37	Slightly metallic	6.50	37	Slight storage flavor	6.50
2	U	40	....	6.50	38	....	6.40	37	Slightly old	6.30	38+	....	6.45	38	....	6.45
	S	40	....	6.30	38	....	6.15	38	....	6.20	38	....	6.30	38	....	6.25
3	U	40	....	6.45	38	....	6.40	38	....	6.35	38+	....	6.50	38	....	6.45
	S	40	....	6.05	38	....	6.05	38	....	5.95	37.5	Slightly oxidized	6.15	38	....	6.05
4	U	39	....	6.70	36	Slightly putrid	6.75	36	Slightly putrid	6.60	37.5	Slightly off	6.75	36	Off	6.55
	S	39	....	6.35	37+	Slightly old	6.30	37+	Slightly old	6.25	37.5	Slightly off	6.40	38	....	6.30
5	U	40	....	6.70	38	....	6.70	38	....	6.60	37.5	Slightly off	6.70	36	Old fat	6.75
	S	40	....	6.30	38	....	6.15	37	Slightly oxidized	6.20	37.5	Slightly oxidized	6.40	38	....	6.25
6	U	40	....	6.70	38+	....	6.75	38	....	6.75	38+	....	6.70	38	....	6.55
	S	40	....	6.25	38	....	6.20	38	....	6.15	38	....	6.45	38	....	6.30
7	U	40	....	6.75	38	....	6.80	38	....	6.55	37.5	Slightly metallic	6.75	36	Stale (visible mold)	6.70
	S	40	....	6.30	38+	....	6.45	38	....	6.25	38	....	6.45	37	Stale	6.35
8	U	40	....	6.70	38+	....	6.65	38	....	6.65	38+	....	6.65	38	....	6.65
	S	40	....	6.25	38+	....	6.10	38	....	6.15	38	....	6.30	38	....	6.15
9	U	40	....	6.60	38+	....	6.60	38	....	6.45	38+	....	6.55	38	....	6.55
	S	40	....	6.15	38+	....	6.10	38+	....	6.10	38	....	6.30	38	....	6.20
10	U	40	....	6.60	38	....	6.65	38	....	6.40	38+	....	6.65	38	....	6.65
	S	40	....	6.20	38+	....	....	38+	....	6.10	38	....	6.35	38	....	6.20

*U = unsalted
S = salted.

TABLE 2. UNSALTED BUTTER MADE FROM SWEET, UNRIPENED CREAM PASTEURIZED AT 165°F. FOR 30 MINUTES
(Total and caseolytic bacterial counts)

Churning no.	Fresh butter		Stored 7 days at 60° F.		Stored 14 days at 60° F.		Stored 113–140 days at 0° F. + 10 days at 60° F.		Typical cultures isolated	
	Total	Caseolytic	Total	Caseolytic	Total	Caseolytic	Total	Caseolytic	Total number	Number Gram-negative rods
1	<100	10	....	....	13,900,000	800,000	40,000,000	4,000,000	5	5
2	<100	10	470,000	<10,000	17,000,000	<100,000	4,400,000	<10,000	3	0
3	<100	20	470,000	20,000	11,000,000	<100,000	38,000,000	<100,000	3	1
4	<100	10	2,800,000	70,000	45,000,000	<100,000	11,000,000	10,000,000	12	12
5	<100	10	7,000,000	....	11,000,000	300,000	500,000	400,000	8	2
6	<100	10	1,000,000	60,000	10,500,000	540,000	13,500,000	<10,000	6	6
7	<100	<10	8,000,000	40,000	15,200,000	90,000	9,000,000	100,000	4	3
8	<100	10	28,000,000	....	23,000,000	200,000	65,000,000	300,000	2	0
9	<100	10	16,300,000	400,000	21,700,000	100,000	80,000,000	<100,000	1	0
10	<100	<10	1,000,000	600,000	16,700,000	600,000	120,000,000	<100,000	2	0

After incubating for one week at 60° F., only one churning showed a deterioration of flavor other than the loss of freshness. The salted and unsalted samples from churning number 4 both showed some deterioration.

Three additional samples showed slight deterioration after the second week of incubation at 60° F. The unsalted samples from churnings 1 and 2, and the salted sample from churning 5 dropped one point each in flavor score, as compared with the scores after one week of incubation. Thus at the end of two weeks' incubation, five samples out of twenty showed some flavor deterioration other than the loss of freshness. Three of these five samples were unsalted and two were salted.

The storage samples were scored while still in a frozen condition. All other samples were scored at approximately 60° F. This may be the reason certain samples were criticized when removed from storage, but were not criticized after a subsequent incubation period at 60° F. In general, it can be said that no definite change in flavor occurred during the cold-storage period.

In order to approximate conditions to which commercial cold-storage butter may be subjected after removal from storage, the above samples were incubated for 10 days at 60° F. At the end of this incubation period, four samples showed flavor deterioration. In the case of the unsalted sample from churning number 7, mold contamination was undoubtedly the cause of deterioration. Of the other three samples, the unsalted sample from churning number 4 showed a similar drop in score with the incubation test. One sample, that of unsalted butter from churning number 1, scored higher after storage and subsequent incubation than it did at the outset. No explanation is offered for this.

Comparing the results of the incubation test with the final scores on the butter after storage and subsequent incubation, four samples showed deterioration with the test but did not show it at the final scoring; three samples showed deterioration at the final scoring but did not show it with the test; and thirteen samples showed the same score with the test that they showed at the final scoring.

The above results indicate that the incubation test is not perfect for predicting the keeping quality of high-grade butter, but that it does give a fairly good indication of what will happen.

As shown by the fact that none of the samples dropped below 36 in flavor score after storage and subsequent incubation, and that only three samples out of twenty fell that low, butter made in this manner has very good keeping qualities. This has been pointed out by several workers (Gray and McKay, 1906; Guthrie and associates, 1936; Palmer and Miller, 1926; and others). There is no indication, however, that unsalted butter keeps better than does mildly salted butter when made in this way. The brine concentrations in this study averaged 9.54 per cent.

pH

The fact has been established that the presence of acid in butter lowers its keeping quality when other factors are equal. Many workers (Gray and McKay, 1906; Guthrie and associates, 1936; Mortensen, 1922; Rogers, 1904; Rogers and Gray, 1909; Wiley, 1939, and others) have pointed this out at various times. In a comprehensive study of the effect of pH on cream churnability and on butter flavor after storage, Guthrie and Sharp

(1931) found that when the pH was below 6, various off flavors developed. They concluded that butter has the best flavor when the pH falls in the range between 6 and 9. Dyer (1916) found that the off flavors commonly occurring in cold-storage butter are attributable to a slow oxidation of one or more of the non-fatty substances occurring in the buttermilk, and that the extent of this change is directly proportional to the quantity of acid present in the original cream from which the butter was made. Holm, Wright, White, and Deysher (1938) state that when the acidity of cream at the time of churning exceeds 0.30 per cent, the resulting butter is inferior in keeping quality to butter made from sweet cream. They attribute this deleterious effect to the increased oxidation of butterfat with the resulting production of off flavors. Loftus-Hills, Scharp, and Bellair (1934) believe that butter acidity and copper content are the most important factors controlling the keeping quality of butter made from neutralized cream. Gilmour and Arup (1935) state that the acidity as indicated by pH is more valuable than that indicated by titratable acidity. They found also that butter of high pH and low in flavor kept better than did butter of low pH and high in flavor. They recommend that the pH be 6.7 or above. Bendixen, Prouty, and Ellington (1937) found that the normal pH range for sweet-cream salted butter was from 6.0 to 6.8, and that butter with the higher pH values had the best keeping quality. They also found that butter made from neutralized cream kept best when the pH was between 6.0 and 6.8. From a study of 5000 churnings of butter, Parsons (1939) concludes that freshly churned butter with a pH of 6.6 to 7.0 has the best keeping qualities. Butter of pH 6.7 kept better than butter with any other pH value.

In the work reported here, ten pH determinations were made on each churning of butter. Five determinations were made on the salted samples and five on the unsalted samples at different times during the period of observation. The results given in table 1 show that the pH of the fresh butter fell between 6.05 and 6.75 for all samples. The pH of the fresh, unsalted butter ranged from 6.45 to 6.75, and the pH of the fresh, salted butter ranged from 6.05 to 6.40. In every case, the pH of the salted sample was lower than that of the unsalted sample from the same churning. The average difference was 0.37 of a pH unit.

To determine whether this effect of sodium chloride on pH was connected in any way with the milk proteins, the salt was added to whole milk, skimmilk, plasma, serum, and serum which had been heated and filtered to remove the albumin. Ten per cent of sodium chloride (C. P.) was added to each sample. Fresh whole milk and fresh skimmilk were used. Part of the skimmilk was coagulated with rennet to remove the casein, and part of this serum was heated to coagulate the albumin. The plasma was obtained from unsalted, sweet-cream butter which had been in cold storage for about a month. The results given below were determined by a glass electrode.

These figures show that milk proteins are not connected with the effect of sodium chloride on pH. The effect probably is due to the influence of this salt on the hydrogen ion. Similar effects have been observed in other connections by physical chemists.

Very little change in pH occurred in any of the butter during the incubation test, during the cold-storage period, or during the incubation period

Sample	pH before adding NaCl	pH after adding NaCl	
		15 minutes	*16 hours*
Whole milk	6.67	6.25	6.18
Skimmilk	6.65	6.22	6.20
Plasma	7.14	6.75	6.68
Serum	6.44	5.99	5.85
Heated serum	6.15	5.56	5.60

after cold storage. The greatest difference between maximum and minimum pH values for any one set of samples was 0.3 of a unit. There seems to be no correlation between change in pH and keeping quality in the butter considered in this study.

Bacteriological study

Much work has been done on the bacteriology of butter, but there seems to be very little agreement concerning the role that bacteria play in the deterioration of butter. Several workers (Bendixon and associates, 1937; Grimes, 1923, 1931; Loftus-Hills et al, 1934; and Nelson, 1932) have reported little or no correlation between total bacteria and keeping quality. Demeter and Maier (1931) found that total count on casein agar was of some value in predicting keeping quality. Jacobsen (1937) noted that the appearance of off flavors in unsalted butter occurred at about the same time that the highest level of total bacteria was reached. Caseolytic and lipolytic bacterial counts have been used as a means of determining keeping quality, but here also Guthrie and associates (1936) and Flake and Parfitt (1938) have found a close correlation, while others (Bendixon and associates, 1937; Demeter and Maier, 1931; Grimes, 1931; and Jacobsen, 1937, 1938) have found little or no correlation.

The results of this study are given in table 2. Counts of lipolytic bacteria were not made since Stark and Scheib (1936) found previously that a high percentage of the lipolytic bacteria in butter are also caseolytic. These investigators also found that in the absence of other factors known to cause butter deterioration and at a temperature favorable for bacterial growth, caseolytic Gram-negative rods were always present in significant numbers in the samples that deteriorated in score. The importance of this type of bacteria has also been pointed out by several investigators (Eckles, 1901; Hammer and Yale, 1932; Herreid and associates, 1934; Rumment, 1931; Sadler and Vollum, 1926; Spitzer and Parfitt, 1929; and Virtanen, 1931). It is not known whether the short, slender rods which Nelson (1932) found to be associated with poor keeping quality were Gram-negative.

In the fresh butter, both total and caseolytic counts were very low. As would be expected, the counts increased greatly during the incubation period. No counts were made on the butter coming from cold storage since it was found that no appreciable change in count took place in the commercial samples during the storage period. However, when the samples were incubated after cold storage, very high counts of total bacteria were found in some instances. In other cases, the counts were about the same as those obtained after the 14-day incubation period. Churnings 4 and 5 had decidedly lower final total counts than they had after the 14-day incubation period. The caseolytic counts are only very rough estimations since it is difficult to obtain accurate counts on this type of organism in mixed cultures. However, the figures given indicate the approximate numbers present.

No conclusions can be drawn as to the relationship of Gram-negative caseolytic rods to the loss of score by the unsalted butter, because the number of samples studied was too small. The deterioration of the unsalted samples from churning number 4 may have been due to this type of bacteria.

Apparently, caseolytic Gram-negative rods can withstand 0° F. for at least 140 days, because this type of organism was isolated from two different samples of butter stored under those conditions.

None of the salted samples contained enough bacteria at any time to be of significance. Of the 13 cultures of caseolytic bacteria isolated from salted butter, none were of the Gram-negative-rod type.

COMMERCIAL BUTTER

The average results of flavor scores, criticisms, pH values, total bacteria, and caseolytic bacteria on 28 commercial churnings of butter are given in tables 3 and 4.

Flavor changes

As shown in table 3, the unsalted samples deteriorated badly in all cases with the incubation test. The unsalted butter in set number 1 did not show as great a drop in score as did the unsalted butter in the other sets. However, the deterioration had already taken place in the cream from which this butter was made, as is indicated by the low score on the fresh butter. As is usually the case, the salted butter showed much better keeping quality with the test than did the unsalted butter. This was not true of the high-grade butter made in the laboratory.

None of the butter deteriorated greatly during the cold-storage period. However, when the storage samples were incubated for ten days at 60° F., the unsalted samples showed drops in flavor scores fairly comparable to the results obtained by the original incubation test. The final scores on the salted samples in set number 1 and set number 3 compared favorably with the results given by the test, but salted samples in set number 2 and set number 4 scored considerably lower.

pH

In all cases, the pH of the unsalted butter dropped markedly during the 14-day incubation period. This drop in pH probably was due to bacterial action and seemed to follow the drop in flavor score rather closely. In contrast, the pH of the salted butter remained constant throughout the period of observation in all cases, regardless of any change in flavor score.

There was very little change in pH during the cold-storage period with either the salted or unsalted butter. When these samples were subjected to an incubation period of 10 days at 60° F., the unsalted samples showed a drop in pH similar to that observed during the initial incubation test.

TABLE 3. AVERAGE FLAVOR SCORES, CRITICISMS, AND pH DETERMINATIONS OF COMMERCIAL SAMPLES

	Fresh butter			Stored 7 days at 60° F.			Stored 14 days at 60° F.			Stored 70–90 days at 0° F.			Stored 70–90 days at 0° F. +10 days at 60°F		
	Score	Flavor criticisms	pH	Score	Flavor criticisms	pH	Score	Flavor criticisms	pH	Score	Flavor criticisms	pH	Score	Flavor criticisms	pH
Set 1: U*	34.55	Old cream Burnt	6.32	33.30	Old cream Cheesy Rancid	5.56	32.70	Old cream Cheesy Rancid Strong	5.50	34.25	Old cream Burnt Storage	6.31	33.60†	Stale, old Unclean Burnt	5.51†
S*	34.50	Old cream Burnt	6.20	34.17	Old cream Strong	6.11	33.61	Old cream Strong	6.12	33.94	Old cream Burnt Strong Storage	6.25	33.25‡	Strong Coarse Stale Unclean	6.15‡
Set 2: U	37.55	Slightly oxidized	6.65	33.10	Cheesy Rancid	5.71	31.30	Rancid Cheesy Roquefort Moldy	5.46	37.25	Slightly oxidized Old Storage	6.82	30.43§	Rancid Cheesy Bitter Stale	5.64§
S	37.55	Slightly oxidized	6.30	37.00	Slightly old Oxidized Coarse	6.25	36.70	Old Oxidized Coarse Strong	6.20	37.00	Slightly old Oxidized Coarse	6.50	35.00§	Oxidized Old Coarse Briny	6.45§
Set 3: U	37.12	Slightly oxidized Slightly acid Grassy	5.90	31.50	Metallic Rancid Roquefort	5.40	31.00	Moldy Rancid Cheesy	5.10	36.50	Old cream Slightly acid	5.90	28.75	Bitter Rancid Cheesy	5.50
S	37.12	Slightly oxidized Slightly acid Grassy	5.80	36.25	Slightly metallic Old, oily Coarse	5.80	35.75	Strong Metallic Old Coarse	5.75	36.37	Old cream Coarse Acid	5.85	35.25	Strong Coarse Old	5.92
Set 4: U	38.00		7.05	37.00	Slightly old Slightly stale	6.55	33.00	Moldy Roquefort Stale	6.24	38.00		7.00	32.00	Putrid Old	6.35
S	38.00		6.77	37.87		6.87	37.62	Old fat	6.74	38.00		6.77	35.50	Slightly old Stale	6.81

*U = unsalted. S = salted. †5 samples. ‡4 samples. §7 samples.

Set 1, 10 churnings of butter made from unripened, neutralized cream pasteurized at 150° F. for 30 minutes.
Set 2, 10 churnings of butter made from unripened, unneutralized cream pasteurized at 145° F. for 30 minutes.
Set 3, 4 churnings of butter made from unripened, unneutralized cream pasteurized at 165° F. for 30 minutes.

TABLE 4. AVERAGE TOTAL AND CASEOLYTIC COUNTS ON COMMERCIAL SAMPLES

	Fresh butter		Stored 7 days at 60° F.		Stored 14 days at 60° F.		Stored 70–90 days at 0° F. +10 days at 60° F.		Typical caseolytic cultures isolated	
	Total	Caseolytic	Total	Caseolytic	Total	Caseolytic	Total	Caseolytic	Total number	Number of Gram-negative rods
Set 1:										
U*	866,000	3,700	23,000,000	2,500,000	33,000,000	3,800,000	73,000,000†	3,000,000†		
S*	102,000	9,400	231,000	13,500	2,400,000	14,000	603,000‡	8,000‡		
Set 2:										
U	182,000	1,800	42,900,000	7,500,000	33,600,000	6,700,000	199,000,000§	>1,000,000	15	14
S	109,000	<1,000	18,700	<100	9,100	<100	5,200§	<100§	7	0
Set 3:										
U	2,900,000	50,000	85,000,000	>1,000,000	17,900,000	>1,000,000	253,000,000	>1,000,000	9	9
S	220,000	1,000	142,000	3,500	139,000	3,500	100,000	2,600	8	0
Set 4:										
U	1,000	100	55,500,000	3,700,000	90,200,000	6,700,000	312,000,000	>1,000,000	20	12
S	2,800	200	3,600	600	9,300	3,000	3,150	700	34	3

*, †, ‡, §—See corresponding footnotes to table 3.

Bacteriological study

Average total and caseolytic bacterial counts are given in table 4. As can be seen, bacteria were of little significance in the deterioration of salted butter. However, they probably were of great significance in the case of the unsalted butter.

A comparison of caseolytic counts and criticisms of the unsalted butter, when held at a temperature favorable for bacterial growth, indicates that the cheesy flavor commonly noticed was probably due to the action of this type of organism. The frequent occurrence of rancid, Roquefort, and strong flavors also may have been due to these organisms, since it was found by Stark and Scheib (1936) that caseolytic bacteria found in butter are usually capable of splitting fat. The method used to find the frequency of occurrence of Gram-negative, proteolytic bacteria in these samples was, at best, only qualitative, but the results indicate that a high percentage of the caseolytic bacteria were of this type. A quantitative study along this line might be of value.

The fact that none of the unsalted butter held at the low temperature developed cheesy, rancid, or Roquefort flavors strongly suggests that microorganisms were responsible for the rapid deterioration at 60° F. Although butter is not commonly held at such a high temperature, it frequently is held under conditions which would permit bacterial development. Consequently, the incubation test is of value for predicting flavor changes due to bacteria in butter subjected to adverse conditions.

SUMMARY AND CONCLUSIONS

Ten churnings of sweet cream butter made under carefully controlled conditions in the laboratory and 28 commercial churnings made in four New York State creameries were subjected to the incubation test in an attempt to predict keeping quality. Samples were obtained from each churning, both before and after salt had been added to the butter. Moisture and salt determinations were made on the salted samples. Flavor score, pH, and total and caseolytic bacterial count were determined on each churning of butter when fresh, at the end of 7 and 14 days at 60° F., after 2 to 5 months in cold storage at 0° F., and after 10 days at 60° F. following the cold-storage period.

BUTTER MADE IN THE LABORATORY

1. The incubation test described here proved fairly reliable as an indication of the keeping quality of both salted and unsalted sweet-cream butter of this type.
2. The butter showed very little loss in flavor score when incubated at 60° F., either before or after cold storage.
3. Mildly salted butter (9.5 per cent NaCl in the brine) had just as good keeping quality as had the unsalted butter.
4. The pH of salted butter made from sweet, unripened cream was found to be somewhat lower than the pH of unsalted butter from the same churning. This probably is due to the effect of NaCl on the hydrogen ion. The higher the NaCl concentration in the plasma, the greater the difference in pH between salted and unsalted butter.

5. The pH of all samples of this butter remained practically constant throughout the period of observation.

COMMERCIAL BUTTER

1. The incubation test proved fairly reliable for predicting the keeping quality of this butter in most cases. Some exceptions occurred with the salted butter in sets 2 and 4.
2. The pH of all samples of unsalted butter that showed losses in flavor score dropped considerably during the incubation period both before and after cold storage. The pH of all salted samples remained practically constant.
3. The flavor criticisms, as well as the results of the bacteriological study, strongly indicate that proteolytic, Gram-negative-rod types of bacteria were largely responsible for the deterioration of the unsalted butter in sets 2, 3, and 4.

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The Incubation Test as an Indication of the Keeping Quality of Butter

H. B. Naylor and E. S. Guthrie

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THE INCUBATION TEST AS AN INDICATION OF THE KEEPING QUALITY OF BUTTER

H. B. NAYLOR AND E. S. GUTHRIE

In recent years, the use of the incubation test for predicting the keeping quality of butter has become widespread in the butter industry. The test is relatively easy to apply; it is inexpensive since it involves very little equipment and time, and it yields results quickly. The industry, therefore, is depending more and more on this test, either alone or in combination with other routine analyses, to predict what will happen to the flavor of a given lot of butter in storage, in trade channels and in the home of the consumer.

Since the incubation test holds such a prominent place among the methods of controlling butter quality at the present time, a further study of the test seemed appropriate. Consequently, this work was undertaken, not with the hope of solving the problem of keeping quality of butter, but with the desire that something might be added to what is already known.

HISTORY OF THE TEST

According to Nelson (1932), Bouska, as early as 1913, used an incubation test similar to the one in use at the present time. He placed two-ounce samples of butter in screw-capped glass jars and incubated them at 15.5°C. for two weeks. Before adopting that temperature, he tried holding the samples at 2° C. but found that this temperature was too low, since the changes that occurred were not comparable with those occurring in channels of distribution.

In 1921, Bouska and Brown reported the use of a rapid test for keeping quality of butter. They suggested that temperatures ranging from 15.5° C. to 21° C. be used in incubating small samples of butter for two weeks. Butter with poor keeping quality developed a bad flavor within three days, while butter with good keeping quality did not develop a bad flavor in two weeks with this test.

A somewhat related test was reported by Sutton (1929). His "bottle test" consisted of placing small amounts of butter in sterile flasks, melting the butter, and allowing it to stand at room temperature for 7 days. He found that this test gave results which confirmed and supplemented results obtained by the plate-count method, and was particularly valuable for the detection of "decomposed" odors. He also concluded that odors due to changes in the sugar and protein fractions of butter are a more reliable indication of biological activity than those which originate from changes in the milkfat.

Another modification of the incubation test was described by Minster (1932). In Minster's work, the butter was held for 4 days at 37°–38° C. and was observed daily for the development of odors. This test was used in conjunction with catalase, reductase, and bacteriological tests. It was found that all four tests when considered together gave a reliable indication of keeping quality, but that the incubation test alone could not be relied upon.

In some work reported by Bendixon, Prouty, and Ellington (1937), it was found that the odor which developed in 67 samples of butter incubated at 21° C. for one week gave little indication of the keeping quality of the same butter stored for one month at 0.5° C. They found that complete flavor scores of butter held in sterile bottles for one week at 21° C. did not check in every case with the stored samples. They stated that the test seemed to be of some value when the butter scored 35 or more in flavor when fresh. Their flavor scores on the incubated butter of this type checked within 0.5 of a point with the flavor scores of the stored butter in 71.4 per cent of the samples.

From his studies of the incubation times and temperatures in relationship to flavor deterioration of butter, Jacobsen (1937) concluded that flavor deterioration in unsalted butter within 7 or 10 days at 21° C. indicated flavor deterioration within 56 days at either 5 or 0° C. However, if the flavor remained unchanged after 7 to 10 days at 21° C., it did not necessarily insure good keeping quality at the lower temperatures. He found that the flavor deterioration of unsalted butter at 15° C. compared more closely with flavor deterioration at lower temperatures than did the results at 21° C., but that a longer period of incubation had to be employed.

Much of the data on the reliability of the incubation test have been collected by commercial butter concerns. Millions of samples of butter have been put through the test, but only a few of the results have been published. Parsons (1938), of the chemical laboratory of Swift and Company, reported that over a period of six years, during which time many thousands of samples of butter were subjected to the incubation test, it was found that holding butter for 14 days at 60° F. gave excellent information regarding the keeping quality and outstanding flavor defects of the butter. The results obtained by holding the butter for 7 days at 68° to 70° F. were similar but not so informative.

Parsons (1939) later reported a summary of results obtained from about 800,000 tests on butter judged for quality before and after incubating for 7 days at 70° F., and about 200,000 tests on butter held for 14 days at 60° F. He states that fairly reliable information as to what will happen to butter handled under average merchandising conditions can be obtained by comparing the scores when butter is carefully scored before and after incubation at 60° F. for 14 days. Butter which had been properly manufactured showed very little loss in score, while butter which had a tendency to deteriorate in trade channels showed about the same deterioration with this test. When the test employing 70° F. for 7 days was used, practically all of the flavor defects of the butter showed up, with the exception of limburger and surface taints. Parsons states that the indications are that butter held 14 days at 60° F. compares favorably with butter held 10 days at 65° to 68° F., and recommends that the latter test be used when trying to detect limburger and surface taints.

SOURCE OF BUTTER

The butter used in this work came from two general sources. A set of ten churnings was made in the butter laboratory of Cornell University by the senior author. The remainder of the samples were obtained from four commercial creameries in New York State.

The butter made in the laboratory was of high quality. Every precaution was taken to insure the best possible keeping quality in the light of what is known about the factors involved. Fresh milk from the Cornell dairy herd was separated with a thoroughly washed and scalded separator. The cream was standardized to 30 per cent fat and immediately pasteurized at 165° F. for 30 minutes. The pasteurization was carried out in a shotgun can immersed in hot water. The can was covered with a metal cover having a small hole in the top just large enough to allow the handle of a stirring rod to pass through. A can of skimmilk was placed in the water bath beside the can of cream and was used for checking the temperature, because the insertion of a thermometer in the cream offered too much opportunity for contamination. Both cans were stirred slowly throughout the pasteurizing process to insure uniform heating.

The high-temperature, holding method of pasteurization was used because several workers (Bendixon and associates, 1937; Guthrie and associates, 1936; Hunziker and associates, 1917; Larsen and associates, 1916; and Wiley, 1939) have reported that butter made from cream pasteurized in this manner, or in a way comparable, has better keeping quality than has butter made from cream pasteurized at lower temperatures. The reason for this has not been found as yet, but it is probably the inactivation of some enzymes which are not inactivated at lower temperatures. Palmer and Combs (1919) found that high-temperature pasteurization retarded the development of tallowiness in butter contaminated with metallic salts, and believed it to be due to the inactivation of natural oxidases present in milk. Palmer and Miller (1926) found that the enhanced keeping quality of butter made from cream pasteurized at high temperatures was not due to the inactivation of peroxidase. Rogers, et al (1912) found that flash pasteurization at temperatures below 150° F. left some factor in the cream which caused a deterioration of the butter. This was not the case when temperatures of 160° F. or higher were used. They also found that, of the common enzymes present in milk, peroxidase was destroyed at 170° F., catalase and lipase at 158° F., and galactase was much weakened between 160° F. and 170° F. but was not completely destroyed even at 200° F. by the flash method of pasteurization. It seems probable that the improvement in keeping quality due to high-temperature pasteurization can be attributed to the inactivation of natural milk enzymes, and perhaps also to the more efficient destruction of microorganisms.

After pasteurization, the cream was cooled immediately to 50° to 55° F. in a water bath. The cooled cream was placed in Dazey churns which had been previously steamed for an hour. The dashers were inserted and the churns were placed in a refrigerator at about 48° F., where they were held over night. The following morning the churns were placed in a water bath at 60° F. and the cream was tempered in this manner for one hour before churning.

After churning, the butter was drained and washed twice. The working was done with wooden ladles on an aluminum working board. Each churning was divided into two portions, salt being added to only half of the butter in each case. Less than one per cent of salt was added in the first two churnings, while the last eight were salted at the rate of 1.5 per cent. A moderate rate of salting was used since the trend in commercial butter seems to be toward mildly salted butter. This trend may be due in part to an increased demand for this type of butter by consumers, but there is some evidence that mildly salted butter has better keeping qualities than has heavily salted butter. Gray and McKay (1906) found that butter containing a low percentage of salt kept better than did butter of the same lot containing a high percentage of salt. It was found by Parsons (1939) that, other things being equal, when the salt content of butter exceeded 2 per cent, there was a tendency for an increasing loss in score.

After the butter was thoroughly worked, four three-ounce, screw-top sample jars were packed with salted butter and four with unsalted butter. The jars, as well as the wooden spatulas used in packing, were previously sterilized by autoclaving. Throughout the making process, every precaution was taken to keep contamination at a minimum.

The samples obtained from commercial plants were taken directly from the churn by men at the plants. Four samples were taken from each churning before salting, and four were taken after salting. All sample jars and spatulas were sterilized before they were sent to the creameries, and careful instructions as to how the samples should be taken were sent to the men in charge of these plants. All samples were sent to the butter laboratory of Cornell University the same day that they were taken. One plant packed with dry ice and one packed with ordinary ice. These samples were sent by express. The other two creameries were near enough to the university so that the samples could be delivered directly.

PROCEDURE

Of the eight samples taken from each churning, one sample of salted butter was analyzed for moisture, salt, total bacteria, caseolytic bacteria, pH, and flavor; the same tests, with the exception of moisture and salt, were made on one sample of the unsalted butter. Two samples each of salted and unsalted butter were placed in an incubator thermostatically controlled to maintain a temperature of 60° F. ± 1°. One pair of these samples was removed at the end of 7 days, and the other pair was incubated for 14 days. The above tests, with the exception of salt and moisture, were made at the end of the 7-day and 14-day periods. The fourth pair of samples was placed in a refrigerator at 0° F., where it was held for approximately three months. There was some variation in the length of time that samples were stored at the low temperature. The first few samples to be removed from cold storage were scored for flavor, plated for total and caseolytic bacterial counts, and the pH was determined. However, after finding that the bacterial counts had not changed appreciably during storage, the procedure was altered slightly for the remaining samples. Instead of using the entire sample, only enough butter was removed from the jar for a flavor score and pH determination. The remainder of the sample was incubated for 10 days at 60° F. and then scored again. A bacterial analysis and pH determination was also made at that time.

METHODS USED

Moisture determinations were made by the Kohmann method. The method suggested by Mojonnier and Troy (1922) was used for determining salt content. The bacterial analyses were made by placing the sample jars in water at 113° F. until the butter was melted. After thoroughly mixing the sample, dilutions were made by using sterile pipettes and water blanks which were warmed to 113° F. before using. All plates were poured with a medium of the following composition:

0.5 per cent beef extract
0.5 per cent yeast extract
0.5 per cent peptone
0.5 per cent glucose
5.0 per cent skimmilk
1.5 per cent agar
Distilled water
pH 7.0

The plates were incubated for 7 days at 68° F. Total counts and caseolytic counts were made on all plates where it was possible to do so. Caseolytic colonies could be detected by the presence of cleared zones in the otherwise turbid medium. Well-isolated representative colonies of this type were placed in litmus milk tubes or were streaked directly on agar slants of the same composition as that of the agar used for plating. These cultures were incubated at 20° C. until their ability to digest casein was confirmed. Eventually, all cultures isolated were streaked on agar slants and Gram stains were made to determine the general type of bacteria involved.

The pH determinations were made by means of a quinhydrone electrode in connection with a saturated calomel half-cell. Fat-free serum was obtained by centrifuging the melted butter in separatory funnels for a short time. The serum was drawn off carefully to prevent mixing with the fat. By placing the serum in a refrigerator for a short time, any remaining fat floated to the surface and solidified. It could then be easily removed. After warming the samples to room temperature again, pH determinations were made.

All flavor-scoring was done by the authors. Samples were removed from the jars by means of sterile wooden spatulas and were scored immediately.

EXPERIMENTAL RESULTS AND DISCUSSION

BUTTER MADE IN THE LABORATORY

Since very little about the accuracy of the incubation test with respect to high-grade butter has been reported in the literature, the work reported here seems appropriate. Because of the limited time available for this study and the fact that it was impossible to obtain the desired type of samples from commercial creameries, it was impossible to study a large number of churnings. Instead, ten churnings of butter were made in the laboratory. Every precaution was taken to minimize all of the factors known at the present time which cause the deterioration of butter, and each churning was carefully studied.

A summary of flavor scores, criticisms, and pH values is given in table 1.

Flavor changes

As is shown in table 1, with the exception of the first churning, all of the fresh butter had an exceptionally good flavor. The slightly cooked flavor due to the high temperature of pasteurization was overlooked since it was not particularly objectionable and always disappeared after a few days.

TABLE 1. BUTTER MADE FROM SWEET, UNRIPENED CREAM, PASTEURIZED AT 165°F. FOR 30 MINUTES
(Flavor scores, criticisms, and pH values)

Churning no.		Fresh butter			Stored 7 days at 60° F.			Stored 14 days at 60° F.			Stored 113–140 days at 0° F.			Stored 113–140 days at 0° F. +10 days at 60° F.		
		Score	Flavor criticism	pH	Score	Flavor criticism	pH	Score	Flavor criticism	pH	Score	Flavor criticism	pH	Score	Flavor criticism	pH
1	U*	37	Slightly off	6.60	37	Slightly old	6.65	36	Old	6.75	37.5	Slightly metallic	6.85	38	....	6.75
	S*	37	Slightly off	6.40	37	Slightly old	6.40	37	Slightly old	6.40	37	Slightly metallic	6.50	37	Slight storage flavor	6.50
2	U	40	....	6.50	38	....	6.40	37	Slightly old	6.30	38+	....	6.45	38	....	6.45
	S	40	....	6.30	38	....	6.15	38	....	6.20	38	....	6.30	38	....	6.25
3	U	40	....	6.45	38	....	6.40	38	....	6.35	38+	....	6.50	38	....	6.45
	S	40	....	6.05	38	....	6.05	38	....	5.95	37.5	Slightly oxidized	6.15	38	....	6.05
4	U	39	....	6.70	36	Slightly putrid	6.75	36	Slightly putrid	6.60	37.5	Slightly off	6.75	36	Off	6.55
	S	39	....	6.35	37+	Slightly old	6.30	37+	Slightly old	6.25	37.5	Slightly off	6.40	38	....	6.30
5	U	40	....	6.70	38	....	6.70	38	....	6.60	37.5	Slightly off	6.70	36	Old fat	6.75
	S	40	....	6.30	38	....	6.15	37	Slightly oxidized	6.20	37.5	Slightly oxidized	6.40	38	....	6.25
6	U	40	....	6.70	38+	....	6.75	38	....	6.75	38+	....	6.70	38	....	6.55
	S	40	....	6.25	38	....	6.20	38	....	6.15	38	....	6.45	38	....	6.30
7	U	40	....	6.75	38	....	6.80	38	....	6.55	37.5	Slightly metallic	6.75	36	Stale (visible mold)	6.70
	S	40	....	6.30	38+	....	6.45	38	....	6.25	38	....	6.45	37	Stale	6.35
8	U	40	....	6.70	38+	....	6.65	38	....	6.65	38+	....	6.65	38	....	6.65
	S	40	....	6.25	38+	....	6.10	38	....	6.15	38	....	6.30	38	....	6.15
9	U	40	....	6.60	38+	....	6.60	38	....	6.45	38+	....	6.55	38	....	6.55
	S	40	....	6.15	38+	....	6.10	38+	....	6.10	38	....	6.30	38	....	6.20
10	U	40	....	6.60	38	....	6.65	38	....	6.40	38+	....	6.65	38	....	6.65
	S	40	....	6.20	38+	....	....	38+	....	6.10	38	....	6.35	38	....	6.20

*U = unsalted
S = salted.

TABLE 2. UNSALTED BUTTER MADE FROM SWEET, UNRIPENED CREAM PASTEURIZED AT 165°F. FOR 30 MINUTES
(Total and caseolytic bacterial counts)

Churning no.	Fresh butter		Stored 7 days at 60° F.		Stored 14 days at 60° F.		Stored 113–140 days at 0° F. +10 days at 60° F.		Typical cultures isolated	
	Total	Caseolytic	Total	Caseolytic	Total	Caseolytic	Total	Caseolytic	Total number	Number Gram-negative rods
1	<100	10	....	....	13,900,000	800,000	40,000,000	4,000,000	5	5
2	<100	10	470,000	<10,000	17,000,000	<100,000	4,400,000	<10,000	3	0
3	<100	20	470,000	20,000	11,000,000	<100,000	38,000,000	<100,000	3	1
4	<100	10	2,800,000	70,000	45,000,000	<100,000	11,000,000	10,000,000	12	12
5	<100	10	7,000,000	....	11,000,000	300,000	500,000	400,000	8	2
6	<100	10	1,000,000	60,000	10,500,000	540,000	13,500,000	<10,000	6	6
7	<100	<10	8,000,000	40,000	15,200,000	90,000	9,000,000	100,000	4	3
8	<100	10	28,000,000	....	23,000,000	200,000	65,000,000	300,000	2	0
9	<100	10	16,300,000	400,000	21,700,000	100,000	80,000,000	<100,000	1	0
10	<100	<10	1,000,000	600,000	16,700,000	600,000	120,000,000	<100,000	2	0

After incubating for one week at 60° F., only one churning showed a deterioration of flavor other than the loss of freshness. The salted and unsalted samples from churning number 4 both showed some deterioration.

Three additional samples showed slight deterioration after the second week of incubation at 60° F. The unsalted samples from churnings 1 and 2, and the salted sample from churning 5 dropped one point each in flavor score, as compared with the scores after one week of incubation. Thus at the end of two weeks' incubation, five samples out of twenty showed some flavor deterioration other than the loss of freshness. Three of these five samples were unsalted and two were salted.

The storage samples were scored while still in a frozen condition. All other samples were scored at approximately 60° F. This may be the reason certain samples were criticized when removed from storage, but were not criticized after a subsequent incubation period at 60° F. In general, it can be said that no definite change in flavor occurred during the cold-storage period.

In order to approximate conditions to which commercial cold-storage butter may be subjected after removal from storage, the above samples were incubated for 10 days at 60° F. At the end of this incubation period, four samples showed flavor deterioration. In the case of the unsalted sample from churning number 7, mold contamination was undoubtedly the cause of deterioration. Of the other three samples, the unsalted sample from churning number 4 showed a similar drop in score with the incubation test. One sample, that of unsalted butter from churning number 1, scored higher after storage and subsequent incubation than it did at the outset. No explanation is offered for this.

Comparing the results of the incubation test with the final scores on the butter after storage and subsequent incubation, four samples showed deterioration with the test but did not show it at the final scoring; three samples showed deterioration at the final scoring but did not show it with the test; and thirteen samples showed the same score with the test that they showed at the final scoring.

The above results indicate that the incubation test is not perfect for predicting the keeping quality of high-grade butter, but that it does give a fairly good indication of what will happen.

As shown by the fact that none of the samples dropped below 36 in flavor score after storage and subsequent incubation, and that only three samples out of twenty fell that low, butter made in this manner has very good keeping qualities. This has been pointed out by several workers (Gray and McKay, 1906; Guthrie and associates, 1936; Palmer and Miller, 1926; and others). There is no indication, however, that unsalted butter keeps better than does mildly salted butter when made in this way. The brine concentrations in this study averaged 9.54 per cent.

pH

The fact has been established that the presence of acid in butter lowers its keeping quality when other factors are equal. Many workers (Gray and McKay, 1906; Guthrie and associates, 1936; Mortensen, 1922; Rogers, 1904; Rogers and Gray, 1909; Wiley, 1939, and others) have pointed this out at various times. In a comprehensive study of the effect of pH on cream churnability and on butter flavor after storage, Guthrie and Sharp

(1931) found that when the pH was below 6, various off flavors developed. They concluded that butter has the best flavor when the pH falls in the range between 6 and 9. Dyer (1916) found that the off flavors commonly occurring in cold-storage butter are attributable to a slow oxidation of one or more of the non-fatty substances occurring in the buttermilk, and that the extent of this change is directly proportional to the quantity of acid present in the original cream from which the butter was made. Holm, Wright, White, and Deysher (1938) state that when the acidity of cream at the time of churning exceeds 0.30 per cent, the resulting butter is inferior in keeping quality to butter made from sweet cream. They attribute this deleterious effect to the increased oxidation of butterfat with the resulting production of off flavors. Loftus-Hills, Scharp, and Bellair (1934) believe that butter acidity and copper content are the most important factors controlling the keeping quality of butter made from neutralized cream. Gilmour and Arup (1935) state that the acidity as indicated by pH is more valuable than that indicated by titratable acidity. They found also that butter of high pH and low in flavor kept better than did butter of low pH and high in flavor. They recommend that the pH be 6.7 or above. Bendixen, Prouty, and Ellington (1937) found that the normal pH range for sweet-cream salted butter was from 6.0 to 6.8, and that butter with the higher pH values had the best keeping quality. They also found that butter made from neutralized cream kept best when the pH was between 6.0 and 6.8. From a study of 5000 churnings of butter, Parsons (1939) concludes that freshly churned butter with a pH of 6.6 to 7.0 has the best keeping qualities. Butter of pH 6.7 kept better than butter with any other pH value.

In the work reported here, ten pH determinations were made on each churning of butter. Five determinations were made on the salted samples and five on the unsalted samples at different times during the period of observation. The results given in table 1 show that the pH of the fresh butter fell between 6.05 and 6.75 for all samples. The pH of the fresh, unsalted butter ranged from 6.45 to 6.75, and the pH of the fresh, salted butter ranged from 6.05 to 6.40. In every case, the pH of the salted sample was lower than that of the unsalted sample from the same churning. The average difference was 0.37 of a pH unit.

To determine whether this effect of sodium chloride on pH was connected in any way with the milk proteins, the salt was added to whole milk, skimmilk, plasma, serum, and serum which had been heated and filtered to remove the albumin. Ten per cent of sodium chloride (C. P.) was added to each sample. Fresh whole milk and fresh skimmilk were used. Part of the skimmilk was coagulated with rennet to remove the casein, and part of this serum was heated to coagulate the albumin. The plasma was obtained from unsalted, sweet-cream butter which had been in cold storage for about a month. The results given below were determined by a glass electrode.

These figures show that milk proteins are not connected with the effect of sodium chloride on pH. The effect probably is due to the influence of this salt on the hydrogen ion. Similar effects have been observed in other connections by physical chemists.

Very little change in pH occurred in any of the butter during the incubation test, during the cold-storage period, or during the incubation period

Sample	pH before adding NaCl	pH after adding NaCl	
		15 minutes	*16 hours*
Whole milk	6.67	6.25	6.18
Skimmilk	6.65	6.22	6.20
Plasma	7.14	6.75	6.68
Serum	6.44	5.99	5.85
Heated serum	6.15	5.56	5.60

after cold storage. The greatest difference between maximum and minimum pH values for any one set of samples was 0.3 of a unit. There seems to be no correlation between change in pH and keeping quality in the butter considered in this study.

Bacteriological study

Much work has been done on the bacteriology of butter, but there seems to be very little agreement concerning the role that bacteria play in the deterioration of butter. Several workers (Bendixon and associates, 1937; Grimes, 1923, 1931; Loftus-Hills et al, 1934; and Nelson, 1932) have reported little or no correlation between total bacteria and keeping quality. Demeter and Maier (1931) found that total count on casein agar was of some value in predicting keeping quality. Jacobsen (1937) noted that the appearance of off flavors in unsalted butter occurred at about the same time that the highest level of total bacteria was reached. Caseolytic and lipolytic bacterial counts have been used as a means of determining keeping quality, but here also Guthrie and associates (1936) and Flake and Parfitt (1938) have found a close correlation, while others (Bendixon and associates, 1937; Demeter and Maier, 1931; Grimes, 1931; and Jacobsen, 1937, 1938) have found little or no correlation.

The results of this study are given in table 2. Counts of lipolytic bacteria were not made since Stark and Scheib (1936) found previously that a high percentage of the lipolytic bacteria in butter are also caseolytic. These investigators also found that in the absence of other factors known to cause butter deterioration and at a temperature favorable for bacterial growth, caseolytic Gram-negative rods were always present in significant numbers in the samples that deteriorated in score. The importance of this type of bacteria has also been pointed out by several investigators (Eckles, 1901; Hammer and Yale, 1932; Herreid and associates, 1934; Rumment, 1931; Sadler and Vollum, 1926; Spitzer and Parfitt, 1929; and Virtanen, 1931). It is not known whether the short, slender rods which Nelson (1932) found to be associated with poor keeping quality were Gram-negative.

In the fresh butter, both total and caseolytic counts were very low. As would be expected, the counts increased greatly during the incubation period. No counts were made on the butter coming from cold storage since it was found that no appreciable change in count took place in the commercial samples during the storage period. However, when the samples were incubated after cold storage, very high counts of total bacteria were found in some instances. In other cases, the counts were about the same as those obtained after the 14-day incubation period. Churnings 4 and 5 had decidedly lower final total counts than they had after the 14-day incubation period. The caseolytic counts are only very rough estimations since it is difficult to obtain accurate counts on this type of organism in mixed cultures. However, the figures given indicate the approximate numbers present.

No conclusions can be drawn as to the relationship of Gram-negative caseolytic rods to the loss of score by the unsalted butter, because the number of samples studied was too small. The deterioration of the unsalted samples from churning number 4 may have been due to this type of bacteria.

Apparently, caseolytic Gram-negative rods can withstand 0° F. for at least 140 days, because this type of organism was isolated from two different samples of butter stored under those conditions.

None of the salted samples contained enough bacteria at any time to be of significance. Of the 13 cultures of caseolytic bacteria isolated from salted butter, none were of the Gram-negative-rod type.

COMMERCIAL BUTTER

The average results of flavor scores, criticisms, pH values, total bacteria, and caseolytic bacteria on 28 commercial churnings of butter are given in tables 3 and 4.

Flavor changes

As shown in table 3, the unsalted samples deteriorated badly in all cases with the incubation test. The unsalted butter in set number 1 did not show as great a drop in score as did the unsalted butter in the other sets. However, the deterioration had already taken place in the cream from which this butter was made, as is indicated by the low score on the fresh butter. As is usually the case, the salted butter showed much better keeping quality with the test than did the unsalted butter. This was not true of the high-grade butter made in the laboratory.

None of the butter deteriorated greatly during the cold-storage period. However, when the storage samples were incubated for ten days at 60° F., the unsalted samples showed drops in flavor scores fairly comparable to the results obtained by the original incubation test. The final scores on the salted samples in set number 1 and set number 3 compared favorably with the results given by the test, but salted samples in set number 2 and set number 4 scored considerably lower.

pH

In all cases, the pH of the unsalted butter dropped markedly during the 14-day incubation period. This drop in pH probably was due to bacterial action and seemed to follow the drop in flavor score rather closely. In contrast, the pH of the salted butter remained constant throughout the period of observation in all cases, regardless of any change in flavor score.

There was very little change in pH during the cold-storage period with either the salted or unsalted butter. When these samples were subjected to an incubation period of 10 days at 60° F., the unsalted samples showed a drop in pH similar to that observed during the initial incubation test.

TABLE 3. AVERAGE FLAVOR SCORES, CRITICISMS, AND pH DETERMINATIONS OF COMMERCIAL SAMPLES

	Fresh butter			Stored 7 days at 60° F.			Stored 14 days at 60° F.			Stored 70–90 days at 0° F.			Stored 70–90 days at 0° F. +10 days at 60°F		
	Score	Flavor criticisms	pH	Score	Flavor criticisms	pH	Score	Flavor criticisms	pH	Score	Flavor criticisms	pH	Score	Flavor criticisms	pH
Set 1:															
U*	34.55	Old cream Burnt	6.32	33.30	Old cream Cheesy Rancid	5.56	32.70	Old cream Cheesy Rancid Strong	5.50	34.25	Old cream Burnt Storage	6.31	33.60†	Stale, old Unclean Burnt	5.51†
S*	34.50	Old cream Burnt	6.20	34.17	Old cream Strong	6.11	33.61	Old cream Strong	6.12	33.94	Old cream Burnt Strong Storage	6.25	33.25‡	Strong Coarse Stale Unclean	6.15‡
Set 2:															
U	37.55	Slightly oxidized	6.65	33.10	Cheesy Rancid	5.71	31.30	Rancid Cheesy Roquefort Moldy	5.46	37.25	Slightly oxidized Old Storage	6.82	30.43§	Rancid Cheesy Bitter Stale	5.64§
S	37.55	Slightly oxidized	6.30	37.00	Slightly old Oxidized Coarse	6.25	36.70	Old Oxidized Coarse Strong	6.20	37.00	Slightly old Oxidized Coarse	6.50	35.00§	Oxidized Old Coarse Briny	6.45§
Set 3:															
U	37.12	Slightly oxidized Slightly acid Grassy	5.90	31.50	Metallic Rancid Roquefort	5.40	31.00	Moldy Rancid Cheesy	5.10	36.50	Old cream Slightly acid	5.90	28.75	Bitter Rancid Cheesy	5.50
S	37.12	Slightly oxidized Slightly acid Grassy	5.80	36.25	Slightly metallic Old, oily Coarse	5.80	35.75	Strong Metallic Old Coarse	5.75	36.37	Old cream Coarse Acid	5.85	35.25	Strong Coarse Old	5.92
Set 4:															
U	38.00		7.05	37.00	Slightly old Slightly stale	6.55	33.00	Moldy Roquefort Stale	6.24	38.00		7.00	32.00	Putrid Old	6.35
S	38.00		6.77	37.87		6.87	37.62	Old fat	6.74	38.00		6.77	35.50	Slightly old Stale	6.81

*U = unsalted. S = salted. †5 samples. ‡4 samples. §7 samples.

Set 1, 10 churnings of butter made from unripened, neutralized cream pasteurized at 150° F. for 30 minutes.
Set 2, 10 churnings of butter made from unripened, unneutralized cream pasteurized at 145° F. for 30 minutes.
Set 3, 4 churnings of butter made from unripened, unneutralized cream pasteurized at 165° F. for 30 minutes.
Set 4, 4 churnings of butter made from unripened, unneutralized cream pasteurized at 165° F. for 30 minutes.

TABLE 4. AVERAGE TOTAL AND CASEOLYTIC COUNTS ON COMMERCIAL SAMPLES

	Fresh butter		Stored 7 days at 60° F.		Stored 14 days at 60° F.		Stored 70–90 days at 0° F. +10 days at 60° F.		Typical caseolytic cultures isolated	
	Total	Caseolytic	Total	Caseolytic	Total	Caseolytic	Total	Caseolytic	Total number	Number of Gram-negative rods
Set 1:										
U*	866,000	3,700	23,000,000	2,500,000	33,000,000	3,800,000	73,000,000†	3,000,000†		
S*	102,000	9,400	231,000	13,500	2,400,000	14,000	603,000‡	8,000‡		
Set 2:										
U	182,000	1,800	42,900,000	7,500,000	33,600,000	6,700,000	199,000,000§	>1,000,000	15	14
S	109,000	<1,000	18,700	<100	9,100	<100	5,200§	<100§	7	0
Set 3:										
U	2,900,000	50,000	85,000,000	>1,000,000	17,900,000	>1,000,000	253,000,000	>1,000,000	9	9
S	220,000	1,000	142,000	3,500	139,000	3,500	100,000	2,600	8	0
Set 4:										
U	1,000	100	55,500,000	3,700,000	90,200,000	6,700,000	312,000,000	>1,000,000	20	12
S	2,800	200	3,600	600	9,300	3,000	3,150	700	34	3

*, †, ‡, §—See corresponding footnotes to table 3.

Bacteriological study

Average total and caseolytic bacterial counts are given in table 4. As can be seen, bacteria were of little significance in the deterioration of salted butter. However, they probably were of great significance in the case of the unsalted butter.

A comparison of caseolytic counts and criticisms of the unsalted butter, when held at a temperature favorable for bacterial growth, indicates that the cheesy flavor commonly noticed was probably due to the action of this type of organism. The frequent occurrence of rancid, Roquefort, and strong flavors also may have been due to these organisms, since it was found by Stark and Scheib (1936) that caseolytic bacteria found in butter are usually capable of splitting fat. The method used to find the frequency of occurrence of Gram-negative, proteolytic bacteria in these samples was, at best, only qualitative, but the results indicate that a high percentage of the caseolytic bacteria were of this type. A quantitative study along this line might be of value.

The fact that none of the unsalted butter held at the low temperature developed cheesy, rancid, or Roquefort flavors strongly suggests that microorganisms were responsible for the rapid deterioration at 60° F. Although butter is not commonly held at such a high temperature, it frequently is held under conditions which would permit bacterial development. Consequently, the incubation test is of value for predicting flavor changes due to bacteria in butter subjected to adverse conditions.

SUMMARY AND CONCLUSIONS

Ten churnings of sweet cream butter made under carefully controlled conditions in the laboratory and 28 commercial churnings made in four New York State creameries were subjected to the incubation test in an attempt to predict keeping quality. Samples were obtained from each churning, both before and after salt had been added to the butter. Moisture and salt determinations were made on the salted samples. Flavor score, pH, and total and caseolytic bacterial count were determined on each churning of butter when fresh, at the end of 7 and 14 days at 60° F., after 2 to 5 months in cold storage at 0° F., and after 10 days at 60° F. following the cold-storage period.

BUTTER MADE IN THE LABORATORY

1. The incubation test described here proved fairly reliable as an indication of the keeping quality of both salted and unsalted sweet-cream butter of this type.
2. The butter showed very little loss in flavor score when incubated at 60° F., either before or after cold storage.
3. Mildly salted butter (9.5 per cent NaCl in the brine) had just as good keeping quality as had the unsalted butter.
4. The pH of salted butter made from sweet, unripened cream was found to be somewhat lower than the pH of unsalted butter from the same churning. This probably is due to the effect of NaCl on the hydrogen ion. The higher the NaCl concentration in the plasma, the greater the difference in pH between salted and unsalted butter.

5. The pH of all samples of this butter remained practically constant throughout the period of observation.

COMMERCIAL BUTTER

1. The incubation test proved fairly reliable for predicting the keeping quality of this butter in most cases. Some exceptions occurred with the salted butter in sets 2 and 4.
2. The pH of all samples of unsalted butter that showed losses in flavor score dropped considerably during the incubation period both before and after cold storage. The pH of all salted samples remained practically constant.
3. The flavor criticisms, as well as the results of the bacteriological study, strongly indicate that proteolytic, Gram-negative-rod types of bacteria were largely responsible for the deterioration of the unsalted butter in sets 2, 3, and 4.

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Uninfected Elm Wood as a Source of the Bark Beetle (*Scolytus multistriatus* Marsham) Carrying the Dutch Elm Disease Pathogen

Donald L. Collins, K. G. Parker, and Henry Dietrich

THE WOODPILE, A BREEDING PLACE OF THE BARK BEETLE
Beetles emerging from the elm wood in the woodpile probably inoculated the adjacent elm tree

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UNINFECTED ELM WOOD AS A SOURCE OF THE BARK BEETLE (*SCOLYTUS MULTISTRIATUS* MARSHAM) CARRYING THE DUTCH ELM DISEASE PATHOGEN

Donald L. Collins, K. G. Parker, and Henry Dietrich[1]

It has been known for several years that bark beetles of the family Scolytidae may carry the Dutch elm disease pathogen, *Ceratostomella ulmi* (Schwarz) Buisman, presumably, for the most part, in the form of spores. Fransen (1939) gives Marchal[2] credit for having been the first to suggest that elm bark beetles were concerned in the transmission of the Dutch elm disease organism. Wollenweber and Stapp (1928), having seen *C. ulmi* in the pupal cells of *Scolytus scolytus* Fabricius, also suggested the relationship between these bark beetles and the fungus. In Europe this relationship has been confirmed by Fransen (1931) and by Fransen and Buisman (1935), not only for *S. scolytus* but also for *Scolytus multistriatus* Marsham. In the United States transmission of the fungus by *S. multistriatus* from infected wood to healthy elms was described by Middleton, Buchanan, May, and Walter in 1935. *S. multistriatus* is now generally considered to be the most effective agent in the transmission of this fungus in the United States.

In order to determine what percentage of beetles in the field were actually carrying inoculum, many specimens of *Scolytus multistriatus* were collected and cultured. They were taken at felled, healthy trees as they alighted for entry, at dead trees which had died from causes other than the Dutch elm disease, at broken branches of uninfected trees, and at piles of freshly cut, healthy elm logs set up to attract them. The percentages of "positive" beetles (beetles from which *Ceratostomella ulmi* was obtained) varied widely from year to year and from locality to locality. In 1935, in the Bronx, New York City, which was at that time in an area of heavy disease incidence, 15 per cent of the 411 specimens of *S. multistriatus* that were collected and cultured were positive. In 1936, from Bronx, Westchester, and Rockland Counties, 7.6 per cent of 688 specimens were positive. In 1937, in Westchester County, 2.9 per cent of 3618 specimens were positive. In 1938, of 225 specimens collected in Yonkers (Westchester County) only 2, or 0.9 per cent, were positive; while in 1939, at Tarrytown, 1 of 9 specimens, and at Hyde Park (Dutchess County), 7 of 122 specimens (percentages of 11.10 and 5.74 respectively) were positive.

When beetles in the disease area carry inoculum to the extent indicated, their origin or source becomes a question of importance. It has already been noted that specimens emerging from wood from diseased trees can carry the spores of the fungus. An idea of the number of beetles carrying the fungus at the time they emerged from such material was gained from

several experiments. Wood from diseased elms which contained colonies of *Scolytus multistriatus* was brought into the laboratory and beetles which emerged from it were cultured. For this purpose, wood which had considerable discoloration in the outermost growth ring, or wood in which coremia of the fungus were found in the pupal cells of the beetles, was chosen. The standard method adopted for treating such wood was to cut it into 20-inch lengths, coat both ends and any other points where wood was exposed with paraffin to retard drying, and place it in small cages. If the beetles were in the pupal stage the wood was cut up and caged immediately after collection. If the beetles had entered only a short time before collection, the wood was usually left in longer pieces. Just before emergence was expected, the wood was cut up and caged. A few inches at each end of the log, where drying was most rapid, were usually discarded. The percentages of emerging beetles carrying spores out of the wood in the several cages varied from 0 to 100. The fungus infestation of the beetles was influenced by the condition of the wood, the extent of the fungus invasion at the time of collection, and the temperature and moisture conditions under which the wood was kept.

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[1] Professor P. A. Readio initiated some of the experiments described in this paper and developed certain techniques used in handling the beetles. Dr. W. H. Rankin, supervisor of Dutch Elm Disease Control of the New York State Department of Agriculture and Markets, and members of his staff, coöperated to the fullest extent, especially in locating beetle material and in facilitating the field observations on diseased trees. Acknowledgment is also due the Boyce Thompson Institute for Plant Research, where the Cornell University Laboratory for Dutch Elm Disease Investigations is located, for coöperation and assistance. Other members of the laboratory staff who had a considerable share in the investigations reported here were Seth Pope, L. L. Pechuman, and L. J. Tyler.

[2] Marchal, E. Rapport sur les résultats des recherches effectuées à la Station de Phyt. de l'État à Gembloux, sur la maladie de l'orme. Soc. Centr. Forest. Belgique. Bul. 35: 162–164. 1927.

Culture records of the progeny of uninfested beetles which were allowed to enter diseased wood in the laboratory or greenhouse also indicated that constancy could not be expected in the numbers of spore-bearing beetles emerging from diseased wood. After entry of the beetles, special treatments, such as dipping the logs in water at regular intervals, boring holes in the ends and sides and keeping them filled with water, and the maintenance of high humidity in the storage chambers, produced results which sometimes varied with the treatments and sometimes independently of them. The highest percentage of positive beetles in the experiments carried out in 1935–36 was 44, with an average of less than 6 in the remaining cages. In 1936–37, the highest percentage of positive beetles from any one cage was 81.8. In these experiments, wood from 4 different sources produced beetles which averaged 41 per cent positive of the 1820 cultured from all cages. Similar variations undoubtedly occur as a result of analogous but uncontrolled and often unknown conditions in the field.

C. W. Collins and his associates (1936) found that beetles could obtain inoculum by feeding in twig crotches of diseased trees, and could transfer it to the brood galleries which they subsequently made. At the Cornell University laboratory in Yonkers, beetles were disinfested externally and allowed to feed on badly wilted, diseased trees. Of the 121 beetles which were alive when removed after feeding two or three days, 15, or 12.4 per cent, were shown by culturing to have acquired inoculum. Cultures of beetles from the same lot, which had not fed on diseased trees, produced no growth of *Ceratostomella ulmi*.

C. W. Collins and his associates also found that beetles emerging from diseased wood could transfer the disease organism to their brood galleries, and reported a number of instances in the field where the fungus was growing in galleries of beetles which had entered uninfected[3] wood. Fransen (1931) recorded coremia growing in pupal cells of *Scolytus scolytus*, and observed that beetles could bring the fungus into the bark by introducing it

into their egg tunnels. The authors of this bulletin have often found dead trees and woodpiles near diseased trees, with evidence that *Scolytus multistriatus* had emerged in great numbers, and in several instances with coremia of *Ceratostomella ulmi* not only in the maternal galleries but also in the pupal cells.

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[3] The term *uninfected* is used in this paper to refer to wood or trees in which, as far as could be determined, there had been no infection by *Ceratostomella ulmi* prior to the death or cutting of the tree or branch involved.

EXPERIMENTS

Observations such as these led to the suspicion that woodpiles and other breeding-wood originating in uninfected trees might have given rise to some of the fungus-infested beetles found in the field. In laboratory experiments, beetles were disinfested to render them less likely to contaminate their galleries with unwanted bacteria and fungi and were then allowed to walk for several hours over coremia of *Ceratostomella ulmi* growing in pure culture on elm twigs. At the end of this period, the most active beetles were selected and placed in cages containing healthy elm logs cut into 20-inch lengths. For experimental purposes the cages were kept under widely different conditions of temperature and humidity. Holes were bored in some of the logs and filled with water at regular intervals. The moisture in others was maintained or increased by regular wetting or dipping. The progeny of the beetles placed in the cages were cultured. The wood in 32 of the 39 cages produced beetles infested with *C. ulmi*. The percentages of positive beetles varied from 0 to 74.4. The total number of beetles cultured was 3028, of which 1106, or 36.5 per cent, carried *C. ulmi*. These figures compared favorably with those obtained from cages of diseased wood, as may be seen by reference to data already given.

It was thus shown that under suitable conditions fungus-infested beetles entering healthy wood give rise to spore-bearing progeny, and also that the percentages of these progeny bearing *Ceratostomella ulmi* are comparable to the percentages of spore-bearing beetles which emerge from wood from diseased trees. Observations and field experiments as described below have confirmed this conclusion, and have indicated that uninfected wood may constitute an important factor in the spread of the Dutch elm disease. The pertinent data are assembled under five headings: (1) trap logs, (2) collection stations, (3) naturally occurring uninfected "beetle-wood" (broken limbs, dead trees, and dead parts of living trees containing *Scolytus multistriatus*), (4) woodpiles, (5) relation of beetle-infested uninfected wood to diseased trees.

TRAP LOGS

Each year, beginning in 1935, trap logs of recently cut, healthy American elm have been placed at several locations in and around the disease area for the purpose of attracting elm bark beetles. The logs were 3 to 4 feet in length and usually from 3 to 8 inches in diameter. Ordinarily they were exposed by leaning them against a stone wall, fence, or similar support in a sunny or partly sunny situation. They were placed in position within a day or two after cutting and brought in for examination at varying intervals. Fresh logs were put out each time exposed logs were collected. The regular periods of exposure were 2 weeks, 4 weeks, and 6 weeks. Logs were examined or caged the day after they were collected.

In 1935, a trap-log station was set up in each of three localities: Armonk, Westchester County; Yonkers, Westchester County; and Pelham Bay

Park, the Bronx, New York City. The stations, while in an area of general disease incidence, were not located with reference to specific diseased trees. The Yonkers station was located in the Boyce Thompson Arboretum (called BTA in some of the tables, as distinguished from the Boyce Thompson Farm, BTF, where a station was established later for other purposes). The logs at Armonk and at Yonkers were heavily infested with *Hylurgopinus rufipes* Eich., almost to the complete exclusion of *Scolytus multistriatus*. Only one gallery of the latter species was found and examined at each of these two stations. *S. multistriatus* galleries were very numerous in the logs exposed at Pelham Bay Park. When the bark was removed, the galleries were examined for coremia of *Ceratostomella ulmi*. Coremia were not found in the gallery from Armonk, but were present in the single gallery from Yonkers, and were found in 75, or 4.6 per cent, of the 1605 galleries examined from Pelham Bay Park. Living beetles were found in some of the newer galleries, and a number of them were removed and cultured. The newer galleries were not examined unless they appeared to be old enough to have allowed time for coremia to develop. The total count of galleries, therefore, may include many which were too new to have produced coremia. Of 146 beetles taken from new galleries at Pelham Bay Park in 1935, 9, or 6.1 per cent, were positive for *C. ulmi*. The data mentioned, together with figures supplementing the remarks which follow, are given in table 1.

In 1936, no galleries of *Scolytus multistriatus* were found in the Armonk logs, and only 5 galleries, which were negative, were found at the Yonkers station. At Pelham Bay Park, the beetles were again numerous, and of 730 galleries examined, 21, or 2.9 per cent, contained coremia of *Ceratostomella ulmi*. Of the 219 beetles which were taken from the maternal tunnels, 60, or 27.4 per cent, were positive. The lower half of one of the Pelham Bay Park logs was placed in a cage to await the emergence of the progeny of the beetles that had entered it in the field. In the upper half of this log, coremia had been found in 8 of about 27 galleries examined from different parts of the inner-bark surface. The percentage of galleries containing coremia was approximately the same as for the total number of galleries examined at the same time from the other logs. The log had been cut on June 29, exposed on June 30, brought in on August 25, and examined and caged immediately. Between September 1 and September 24, beetles were emerging and 53 specimens of *S. multistriatus* were collected. Of these, 48 were cultured and 30, or 62.5 per cent, were positive for *C. ulmi*. The log was removed from the cage in October and left on a rack out-of-doors all winter. It was caged again the following spring, and 223 of the 359 beetles which emerged were cultured between June 1 and July 17. Of these, 4, or 1.8 per cent, were positive.

In 1936, eight additional trap-log stations were located at the edge of the known disease area near the stumps of removed diseased trees. At four of these stations *Scolytus multistriatus* entered the logs, and from two of them *Ceratostomella ulmi* was cultured from recently entered beetles (table 1).

In 1937, the galleries were not systematically examined for coremia. However, while the beetle counts were being made, coremia were found in pupal cells and maternal galleries in one of the Pelham Bay Park logs. Half of this log was caged and produced positive beetles.

TABLE 1. RESULTS OF EXAMINING SCOLYTUS MULTISTRIATUS GALLERIES IN TRAP LOGS FOR COREMIA OF CERATOSTOMELLA ULMI; CULTURING RECENTLY ENTERED SPECIMENS OF S. MULTISTRIATUS; AND CULTURING THE EMERGING PROGENY

Location		Year	1. Galleries			2. Recently entered living beetles			3. Emerging progeny of 2		
Town or city	County		Number examined	Number with coremia	Per cent with coremia	Number cultured	Positive		Number cultured	Positive	
							Number	Per cent		Number	Per cent
Armonk	Westchester	1935	1	0	0.0	0	..	...	0	..	...
Yonkers	Westchester	1935	1	1	100.0	0	..	...	0	..	...
Pelham	Bronx	1935	1,605	75	4.6	146	9	6.1	0	..	...
Yonkers	Westchester	1936	5	0	0.0	0	..	...	0	..	...
Pelham	Bronx	1936	730	21	2.9	219	60	27.4	48	30	62.5
Mahopac (1)	Putnam	1936	52	0	0.0	12	0	0.0	0	..	...
Mahopac (2)	Putnam	1936	1	0	0.0	0	..	...	0	..	...
Harriman	Orange	1936	52	0	0.0	23	1	4.4	0	..	...
Monroe	Orange	1936	47	2	4.2	22	2	9.1	0	..	...
Pelham	Westchester	1937	few	few	..	0	..	...	111	4	3.6

The data from the Pelham Bay Park station (called Pelham in the table) for 1936 are the most complete. These point to a significant relationship; namely, that not all spore-bearing beetles which enter healthy logs give rise to fungus-infested colonies, but that the few infested colonies may give rise to spore-bearing beetles in numbers larger than those originally entering. Further evidence of a possible "build-up" of *Ceratostomella ulmi* in healthy logs was obtained from data from the logs placed at the collection stations.

COLLECTION STATIONS

In addition to the regular trap-log stations, after 1936 other stations which were called *collection stations* were set up. In 1937 and 1938, a collection station consisted of a group of healthy elm logs, about 4 feet in length and of varying diameters, set up in the form of a "tepee", with their bases resting on the ground in a small circle and their upper ends leaning against one another. In 1939, at many of the stations, the logs were piled horizontally. A complete list of the stations is given in table 3. The four locations in Westchester County were in the area where the disease was generally prevalent. The stations in Putnam and Dutchess Counties were established at known distances from removed diseased trees. The distance from a station to the nearest diseased tree varied from a few feet to nearly 2 miles (table 3).

Two significant types of records were taken from these collection stations: (1) culture data from beetles collected as they alighted on the logs in the course of their normal free activities; and (2) culture data from the progeny of such beetles, obtained by collecting and culturing specimens that emerged from some of the logs which had been brought in and caged. The only field-collected specimens discussed here are those collected at stations where a culture record was also obtained from some of their progeny emerging from logs brought in and caged. At the time the stations were set up, several of the logs at each station were paraffined to retard drying so that they might be used later as a source of beetles for cul-

turing. These logs were left in the field until nearly time for beetle emergence, then brought in, cut into smaller pieces, paraffined, and caged. In the experiments discussed under the heading "Trap Logs", the logs which were caged were selected because coremia of *Ceratostomella ulmi* had been found in the galleries; the logs discussed under "Collection Stations" were chosen at random. At the time the latter were caged, examinations revealed abundant growth of coremia in maternal tunnels and pupal cells in several of the logs.

Table 2 includes all data obtained from 1937 through 1939 where cultural studies were made both of the entering beetles and of the progeny of the brood which developed in the logs at the stations.

TABLE 2. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS ENTERING HEALTHY ELM WOOD AT COLLECTION STATIONS AND EMERGING FROM THAT WOOD

Location		Beetles				
Town or city	County	Time of collection and culturing	Status of beetles	Number cultured	Number positive	Per cent positive
Yonkers (BTA)	Westchester	Spring, summer, '37	1st brood entering	483	27	5.59
		Summer, fall, '37	Progeny emerging	597	79	13.23
Yonkers (BTF)	Westchester	Summer, '37	2d brood entering	758	7	0.93
		Spring, '38	Progeny emerging	382	237	62.00
Yonkers (BTF)	Westchester	Summer, fall, '38	2d brood entering	225	2	0.88
		Spring, '39	Progeny emerging	348	7	2.05
Ardsley	Westchester	Spring, '39	1st brood entering	38	0	0.00
		Summer, '39	Progeny emerging	59	5	8.47
Tarrytown	Westchester	Spring, '39	1st brood entering	9	1	11.10
		Summer, '39	Progeny emerging	42	1	2.38
Hyde Park	Dutchess	Spring, '39	1st brood entering	122	7	5.74
		Summer, '39	Progeny emerging	71	27	38.01

In 1939 culture records were made of the progeny of beetles which entered logs exposed at several stations where no cultures had been made of the entering beetles. Table 3 includes data obtained in this way from the stations set up that year. The names of the stations which appear also in table 2 are starred in table 3.

TABLE 3. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS EMERGING FROM HEALTHY ELM WOOD FROM COLLECTION STATIONS, SUMMER OF 1939, 2D BROOD EMERGING

Location		Number of beetles cultured	Number of beetles positive	Per cent of beetles positive	Distance to nearest confirmed tree	
Town or city	County				1938	1939
Yonkers (BTF)	Westchester	157	0	0.00	1400 feet	3000 feet
Yonkers (BTA)	Westchester	95	0	0.00	1800 feet	2000 feet
Ardsley*	Westchester	59	5	8.47	1600 feet	1000 feet
Tarrytown*	Westchester	42	1	2.38	200 feet	3500 feet
Patterson	Putnam	23	0	0.00	1¾ miles	1 mile
Schultzeville	Dutchess	218	0	0.00	200 feet	4000 feet
Stanford	Dutchess	76	1	1.31	25 feet	2½ miles
S. Millbrook	Dutchess	3	0	0.00	1 mile	1½ miles
Poughkeepsie	Dutchess	117	2	1.70	4000 feet	2000 feet
Hyde Park*	Dutchess	71	27	38.01	2 feet	1 mile

*See also table 2.

NATURALLY OCCURRING UNINFECTED BEETLE-WOOD

In 1937, in an open field, about one mile from the nearest known diseased tree, a 24-inch elm was found which had been struck by lightning shortly before the first of June. This tree, which was near Washingtonville, in Orange County, was discovered on July 31. Examination and tissue-culturing gave no evidence of infection by *Ceratostomella ulmi*. The branches contained a large number of colonies of *Scolytus multistriatus*. Beetles were both entering and emerging, and were present in all stages. Samples of the wood were brought into the laboratory for beetle emergence. The data obtained are presented in table 4, together with data obtained from other wood as described below.

On August 18, 1938, in Ardsley, Westchester County, a tree which had been killed the preceding year by girdling was found to be heavily infested with *Scolytus multistriatus*, specimens of which were emerging at the time of discovery. This tree was a few feet from a diseased tree which was removed the same day the girdled tree was removed. A portion of the girdled tree was cut up and caged, and beetles emerging were cultured. The data appear in table 4.

TABLE 4. Results of Culturing Scolytus multistriatus Emerging from Field-collected Uninfected Wood

Location		Type of material	Time of collection	Time of beetle emergence and culturing	Beetles		
Town or city	County				Number cultured	Number positive	Per cent positive
Washingtonville	Orange	Lightning-struck	Aug. 1937	Aug. 1937	559	12	2.15
Ardsley	Westchester	Girdled tree	Aug. 1938	Aug. 1938	202	34	16.83
Ghent	Columbia	Lightning-struck	Mar. 1939	May-June, 1939	2	0	0.00
Tivoli	Dutchess	Dead limb	Mar. 1939	May-June, 1939	120	0	0.00
Sharon Station	Dutchess	Dead tree	Mar. 1939	May-June, 1939	98	0	0.00
Poughkeepsie (1)	Dutchess	Windfall	Mar. 1939	May-June, 1939	19	0	0.00
Poughkeepsie (2)	Dutchess	Broken limb	Mar. 1939	May-June, 1939	37	4	10.81
Warwick	Orange	Windfall	Mar. 1939	May-June, 1939	107	0	0.00
Stony Ford	Orange	Broken limb	Mar. 1939	May-June, 1939	66	0	0.00
Little Britain	Orange	Dead tree	Mar. 1939	May-June, 1939	85	6	7.06
Goshen (1)	Orange	Broken limb	Mar. 1939	May-June, 1939	71	1	1.41
Goshen (2)	Orange	Uncertain*	Mar. 1939	May-June, 1939	71	18	25.35
Edenville	Orange	Dead tree	Mar. 1939	May-June, 1939	78	1	1.28

*Material brought in by a field worker and was accompanied by no description of the exact source.

During the month of March in 1939, wood containing overwintering larvae of *Scolytus multistriatus* was collected at several points in the disease area, but without reference to the locations of known diseased trees. The distances to known diseased trees were determined later. The wood came from such material as broken limbs, trees which had been blown down, and trees dead from causes other than the Dutch elm disease. The wood was examined for discoloration which might indicate origin in a diseased tree. If it came from trees which were still partly alive, the living portions were also examined. If any streaking was found, tissue cultures were made. In no instance was *Ceratostomella ulmi* obtained, and it was assumed that none of the wood used was from infected trees. The pieces of wood generally ranged from 4 to 6 inches in diameter. The ends were paraffined and

the wood was stored out-of-doors. On May 8, the material was caged. The results of culturing the emerging beetles are given in table 4.

The locations from which the wood produced no positive beetles varied in distance from 3½ miles to 20 miles from the nearest known diseased tree of the previous year. The sites from which *Ceratostomella ulmi* was obtained were located from a few feet to 2 miles from the nearest confirmed tree of the previous year.

WOODPILES

On August 11, 1938, a considerable amount of elm wood was found in a pile of stovewood on a farm about five miles east of Poughkeepsie. Many pieces of this wood contained larvae and pupae of *Scolytus multistriatus*. On the same day, examination of another pile at Hyde Park revealed similar conditions. The Poughkeepsie woodpile was 1½ miles from the nearest diseased tree found in 1938. The Hyde Park woodpile was about 500 feet from the nearest confirmed tree of 1938. Pieces from each pile were brought in and caged separately. The data obtained from the cages are presented in table 5.

TABLE 5. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS EMERGING FROM WOOD TAKEN FROM WOODPILES IN AUGUST, 1938

Location		Beetles		
Town or city	County	Number cultured	Number positive	Per cent positive
Poughkeepsie	Dutchess	144	1	0.69
Hyde Park	Dutchess	130	0	0.00

The two most common farm methods of storing stovewood are piling it in a more or less open shed and piling it out-of-doors. Experiments were made to determine the relative safety of these two methods of storage with respect to the survival of *Ceratostomella ulmi* and the emergence of beetles carrying the fungus. The experiments involved both diseased wood containing *Scolytus multistriatus* and healthy wood in which spore-bearing beetles had been allowed to breed. In order that normal conditions would obtain, the ends of the logs were not paraffined.

Heavily discolored, beetle-infested, diseased wood was cut into lengths of 15 to 18 inches and distributed among three locations in Orange County. At each location, two piles were made: one inside of a shed, supported off the ground by the lower logs or other supports, and the other outside, piled closely on the ground beside the shed.

The healthy wood was cut into four-foot lengths and stored in a cellar for 18 days, after which it was cut into 15- to 18-inch lengths and caged in the greenhouse with beetles which had been artificially infested with spores of the fungus. After 9 days the logs were taken from the cages and separated into 2 lots. One lot was piled on the wooden floor of a shed at Yonkers and the other was piled outside against the north side of the shed.

In both series of experiments, the wood was left under the described conditions for five or six weeks. It was then brought to the laboratory and caged. The cages of diseased wood were kept out-of-doors on racks

in a large, wire-screen cage. The healthy wood was placed in cages in the greenhouse. Data from these experiments are presented in table 6.

TABLE 6. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS EMERGING FROM SMALL LOGS PILED AS STOVEWOOD, SUMMER, 1939

Location	Description of material	Conditions of storage	Emerging beetles		
			Number cultured	Number positive	Per cent positive
Florida, New York	Field-collected diseased wood containing beetles	(a) In shed (b) Outside shed in shade	99 119	6 5	6.1 4.2
Pine Island	Field-collected diseased wood containing beetles	(a) In shed (b) Outside shed on west side in sun among weeds	135 107	13 18	9.6 16.8
Little York (near Pine Island)	Field-collected diseased wood containing beetles	(a) In shed (b) Outside shed on east side in sun	47 38	2 0	4.3 0.0
Totals	Field-collected diseased wood containing beetles	(a) In sheds (b) Outside sheds	281 264	21 23	7.5 8.7
Yonkers (BTF)	Healthy wood entered by fungus-infested beetles	(a) In shed (b) Outside shed on north side	103 115	20 16	19.4 13.9

It is noted that healthy wood entered by fungus-infested beetles produced a higher percentage of positive specimens than did diseased wood. It was concluded that the storage of untreated, beetle-infested wood out-of-doors or in an ordinary barn or woodshed is unsafe, whether or not the wood is diseased.

RELATION OF BEETLE-INFESTED UNINFECTED WOOD TO DISEASED TREES

When trees in the field are examined at random, feeding by *Scolytus multistriatus* in the twig crotches of living elms appears rather erratic. It was pointed out by Donald L. Collins (1938) that trees adjacent to wood which is either attracting or producing beetles, and trees containing such wood are most likely to be visited for feeding. Since 1938, additional data from laboratory and field experiments and from general observations have indicated that the wood from which beetles are emerging is the more important, since they feed heavily on near-by trees. Wolfenbarger and Buchanan (1939) and Fransen (1939) have made similar observations.

Of the 304 trees confirmed as diseased in the counties of Ulster, Columbia, and Dutchess in 1939, 217 were inspected by members of the laboratory staff to determine the extent of beetle-feeding and the year of infection. The vicinity of each tree was scouted for sources of *Scolytus multistriatus*, and maps were drawn of each site. The number of trees recorded as having become infected during the spring and summer of 1939 was 127.

The approximate time of beetle emergence from a given source, the approximate age of feeding wounds, and the time of infection of diseased trees could usually be determined within reasonable limits. It was ordinarily possible, therefore, to ascertain whether the wounds on a given diseased tree were made by beetles emerging from near-by wood at the proper time to cause that specific infection. In the vicinity of 65 of the 127 trees, a definite beetle source, from which beetles had emerged in the

spring or early summer of 1939, was found within 700 feet. The sources of beetles consisted of dead branches, broken branches (both those still hanging in the tree and those which had fallen to the ground), felled trees, trees blown over by the wind, and woodpiles. In several instances, the source of beetles was located in the diseased tree itself. Sources of this type were in parts of the tree which had broken off or had died before the time of infection, and which had attracted beetles whose progeny fed upon and presumably inoculated the tree. Nearly half of the 65 trees in question had beetle sources of the types described within 25 feet. Figures relative to the diseased trees and beetle sources are presented in table 7.

TABLE 7. LOCATIONS OF SOURCES OF SCOLYTUS MULTISTRIATUS IN UNINFECTED WOOD WITH REFERENCE TO LOCATIONS OF DISEASED TREES IN 1939

Description of diseased tree	Number of trees within specified distances of beetle sources in uninfected wood			
	650 feet	500 feet	100 feet	In or under tree or within 25 feet
Single	27	26	18	16
In groups of 2 or more	38	36	23	13
Total	65	62	41	29

Of the remaining 62 trees, not included in table 7, which were inspected and judged to constitute 1939 infections, all but two occurred singly; that is, they were not associated with other diseased trees. These 62 trees are considered separately because they were not definitely related to beetle material from which it could be determined that emergence had taken place in the spring of 1939. Nearly all of them, however, were in swamps or in other unfavorable situations, and usually there was a considerable amount of dead wood in the vicinity. Much of this dead wood was inaccessible for close observation, but in most instances evidence of the presence of *Scolytus multistriatus* was found.

There were a few sites where no sources of *Scolytus multistriatus* could be found in the immediate vicinity of the diseased tree, but where there were sources of *Hylurgopinus rufipes* within 500 feet. *Scolytus sulcatus* LeC. was found not infrequently breeding in or near diseased trees.

With the exception of one group of 2 trees, whenever 2 or more diseased trees were found associated with one another, a source of *Scolytus multistriatus* was definitely established. Thus, a total of 40 trees with 1939 infections were found in groups of 2 to 7 trees, and, as may be noted in table 7, 38 of the 40 trees were definitely associated with a source of beetles. From these observations, it appeared that wherever a number of trees were inoculated by beetles from the same source, that source was usually large and easily found.

An example of what can happen when beetles are allowed to build up a heavy population in a limited area was seen in a swamp near Kingston during March, 1940. A low area adjacent to a small pond had a large elm population including trees of all diameters up to about 25 inches. The area was roughly 500 feet long by 300 feet wide. Sometime prior to 1939 the area had been flooded, resulting in the death of many trees, which became infested by *Scolytus multistriatus*. Emergence in large numbers

from these trees first took place in the spring of 1939, and the beetles fed heavily on the adjacent trees during that period. Nearly all of the living trees were sampled and 33 were confirmed. No confirmed tree was more than 100 feet distant from a beetle source, from which beetles had emerged in the spring of 1939, and all of the infections had occurred during that period.

In the instances cited usually no opportunity was offered for culturing the suspected beetles, since they had fed and disappeared by the time the diseased trees were seen and removed. Such an opportunity occurred in one case, however, when a broken branch on an uninfected tree near Poughkeepsie was found to contain colonies of *Scolytus multistriatus* in March, 1939 (Poughkeepsie (2) in table 4). A section of the limb was brought in, and from this section 37 beetles, which emerged in May and June, were cultured. Of these, 4, or 10.8 per cent, were positive. In the meantime, the rest of this limb, which had been left as it was found, was producing beetles, as evidenced by subsequent examination. During the summer, a tree about 50 feet distant became infected with the Dutch elm disease. The nearest confirmed tree the previous season had been a mile away. The circumstances inevitably suggest the cause-and-effect relationship assumed with respect to the trees mentioned above as being associated with known beetle sources.

SUMMARY AND CONCLUSIONS

As high as 15 per cent of the specimens of *Scolytus multistriatus* collected in the field in southeastern New York State were found, by culturing, to be carrying the Dutch elm disease pathogen *Ceratostomella ulmi*. When cultured directly after emerging from diseased wood, as high as 100 per cent of the beetles were positive for *C. ulmi*, but usually they averaged considerably less than 50.

When beetles were artificially infested with spores and allowed to enter healthy wood, as high as 74 per cent of their progeny emerged carrying spores of *Ceratostomella ulmi*. Healthy cut logs exposed to normal beetle attack in the field produced as high as 62 per cent of positive beetles in the progeny of parents which probably averaged much lower when entering. Pieces of uninfected beetle-wood found in the field produced as high as 25 per cent of positive beetles.

Uninfected elm wood in farmers' woodpiles also produced positive beetles. Diseased wood cut in short lengths and piled produced as high as 16 per cent of positive beetles when stored out-of-doors and as high as 9 per cent when stored in sheds. Healthy wood cut and stored in a similar way, but subjected to entry by spore-bearing beetles, produced 14 per cent of positive beetles when stored out-of-doors and 19 per cent when stored in a shed.

In 1939, in the counties of Ulster, Columbia, and Dutchess, that is, in the peripheral regions of the disease area, 217 of the 304 confirmed trees were inspected. Of these, 127 were recorded as having become infected in 1939. In the vicinity of 65 of these trees, uninfected wood which had produced *Scolytus multistriatus* in the spring or early summer of 1939 was discovered. In these instances there appeared to be a definite correlation of beetle emergence and beetle feeding with the probable time of infection.

This led to the inference that the disease pathogen was communicated to these trees by beetles which had emerged from uninfected wood. Whether this inference is justified in every instance, it was shown that uninfected wood can, and often does, produce beetles which carry inoculum. Dead or dying elm wood of whatever origin, if suitable for the breeding of *Scolytus multistriatus*, is therefore a potential source of inoculum from which the Dutch elm disease pathogen may be spread by emerging beetles. Since the beetles can carry the fungus into uninfected wood, and their progeny can carry it out, such wood serves as a reservoir for continuing local dissemination of the disease organism. It may also act as a bridge for the transfer of the fungus from the disease area to regions where the disease does not occur.

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Uninfected Elm Wood as a Source of the Bark Beetle (*Scolytus multistriatus* Marsham) Carrying the Dutch Elm Disease Pathogen

Donald L. Collins, K. G. Parker, and Henry Dietrich

THE WOODPILE, A BREEDING PLACE OF THE BARK BEETLE
Beetles emerging from the elm wood in the woodpile probably inoculated the adjacent elm tree

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UNINFECTED ELM WOOD AS A SOURCE OF THE BARK BEETLE (*SCOLYTUS MULTISTRIATUS* MARSHAM) CARRYING THE DUTCH ELM DISEASE PATHOGEN

Donald L. Collins, K. G. Parker, and Henry Dietrich[1]

It has been known for several years that bark beetles of the family Scolytidae may carry the Dutch elm disease pathogen, *Ceratostomella ulmi* (Schwarz) Buisman, presumably, for the most part, in the form of spores. Fransen (1939) gives Marchal[2] credit for having been the first to suggest that elm bark beetles were concerned in the transmission of the Dutch elm disease organism. Wollenweber and Stapp (1928), having seen *C. ulmi* in the pupal cells of *Scolytus scolytus* Fabricius, also suggested the relationship between these bark beetles and the fungus. In Europe this relationship has been confirmed by Fransen (1931) and by Fransen and Buisman (1935), not only for *S. scolytus* but also for *Scolytus multistriatus* Marsham. In the United States transmission of the fungus by *S. multistriatus* from infected wood to healthy elms was described by Middleton, Buchanan, May, and Walter in 1935. *S. multistriatus* is now generally considered to be the most effective agent in the transmission of this fungus in the United States.

In order to determine what percentage of beetles in the field were actually carrying inoculum, many specimens of *Scolytus multistriatus* were collected and cultured. They were taken at felled, healthy trees as they alighted for entry, at dead trees which had died from causes other than the Dutch elm disease, at broken branches of uninfected trees, and at piles of freshly cut, healthy elm logs set up to attract them. The percentages of "positive" beetles (beetles from which *Ceratostomella ulmi* was obtained) varied widely from year to year and from locality to locality. In 1935, in the Bronx, New York City, which was at that time in an area of heavy disease incidence, 15 per cent of the 411 specimens of *S. multistriatus* that were collected and cultured were positive. In 1936, from Bronx, Westchester, and Rockland Counties, 7.6 per cent of 688 specimens were positive. In 1937, in Westchester County, 2.9 per cent of 3618 specimens were positive. In 1938, of 225 specimens collected in Yonkers (Westchester County) only 2, or 0.9 per cent, were positive; while in 1939, at Tarrytown, 1 of 9 specimens, and at Hyde Park (Dutchess County), 7 of 122 specimens (percentages of 11.10 and 5.74 respectively) were positive.

When beetles in the disease area carry inoculum to the extent indicated, their origin or source becomes a question of importance. It has already been noted that specimens emerging from wood from diseased trees can carry the spores of the fungus. An idea of the number of beetles carrying the fungus at the time they emerged from such material was gained from

several experiments. Wood from diseased elms which contained colonies of *Scolytus multistriatus* was brought into the laboratory and beetles which emerged from it were cultured. For this purpose, wood which had considerable discoloration in the outermost growth ring, or wood in which coremia of the fungus were found in the pupal cells of the beetles, was chosen. The standard method adopted for treating such wood was to cut it into 20-inch lengths, coat both ends and any other points where wood was exposed with paraffin to retard drying, and place it in small cages. If the beetles were in the pupal stage the wood was cut up and caged immediately after collection. If the beetles had entered only a short time before collection, the wood was usually left in longer pieces. Just before emergence was expected, the wood was cut up and caged. A few inches at each end of the log, where drying was most rapid, were usually discarded. The percentages of emerging beetles carrying spores out of the wood in the several cages varied from 0 to 100. The fungus infestation of the beetles was influenced by the condition of the wood, the extent of the fungus invasion at the time of collection, and the temperature and moisture conditions under which the wood was kept.

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[1] Professor P. A. Readio initiated some of the experiments described in this paper and developed certain techniques used in handling the beetles. Dr. W. H. Rankin, supervisor of Dutch Elm Disease Control of the New York State Department of Agriculture and Markets, and members of his staff, coöperated to the fullest extent, especially in locating beetle material and in facilitating the field observations on diseased trees. Acknowledgment is also due the Boyce Thompson Institute for Plant Research, where the Cornell University Laboratory for Dutch Elm Disease Investigations is located, for coöperation and assistance. Other members of the laboratory staff who had a considerable share in the investigations reported here were Seth Pope, L. L. Pechuman, and L. J. Tyler.

[2] Marchal, E. Rapport sur les résultats des recherches effectuées à la Station de Phyt. de l'État à Gembloux, sur la maladie de l'orme. Soc. Centr. Forest. Belgique. Bul. 35: 162–164. 1927.

Culture records of the progeny of uninfested beetles which were allowed to enter diseased wood in the laboratory or greenhouse also indicated that constancy could not be expected in the numbers of spore-bearing beetles emerging from diseased wood. After entry of the beetles, special treatments, such as dipping the logs in water at regular intervals, boring holes in the ends and sides and keeping them filled with water, and the maintenance of high humidity in the storage chambers, produced results which sometimes varied with the treatments and sometimes independently of them. The highest percentage of positive beetles in the experiments carried out in 1935–36 was 44, with an average of less than 6 in the remaining cages. In 1936–37, the highest percentage of positive beetles from any one cage was 81.8. In these experiments, wood from 4 different sources produced beetles which averaged 41 per cent positive of the 1820 cultured from all cages. Similar variations undoubtedly occur as a result of analogous but uncontrolled and often unknown conditions in the field.

C. W. Collins and his associates (1936) found that beetles could obtain inoculum by feeding in twig crotches of diseased trees, and could transfer it to the brood galleries which they subsequently made. At the Cornell University laboratory in Yonkers, beetles were disinfested externally and allowed to feed on badly wilted, diseased trees. Of the 121 beetles which were alive when removed after feeding two or three days, 15, or 12.4 per cent, were shown by culturing to have acquired inoculum. Cultures of beetles from the same lot, which had not fed on diseased trees, produced no growth of *Ceratostomella ulmi*.

C. W. Collins and his associates also found that beetles emerging from diseased wood could transfer the disease organism to their brood galleries, and reported a number of instances in the field where the fungus was growing in galleries of beetles which had entered uninfected[3] wood. Fransen (1931) recorded coremia growing in pupal cells of *Scolytus scolytus*, and observed that beetles could bring the fungus into the bark by introducing it

into their egg tunnels. The authors of this bulletin have often found dead trees and woodpiles near diseased trees, with evidence that *Scolytus multistriatus* had emerged in great numbers, and in several instances with coremia of *Ceratostomella ulmi* not only in the maternal galleries but also in the pupal cells.

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[3] The term *uninfected* is used in this paper to refer to wood or trees in which, as far as could be determined, there had been no infection by *Ceratostomella ulmi* prior to the death or cutting of the tree or branch involved.

EXPERIMENTS

Observations such as these led to the suspicion that woodpiles and other breeding-wood originating in uninfected trees might have given rise to some of the fungus-infested beetles found in the field. In laboratory experiments, beetles were disinfested to render them less likely to contaminate their galleries with unwanted bacteria and fungi and were then allowed to walk for several hours over coremia of *Ceratostomella ulmi* growing in pure culture on elm twigs. At the end of this period, the most active beetles were selected and placed in cages containing healthy elm logs cut into 20-inch lengths. For experimental purposes the cages were kept under widely different conditions of temperature and humidity. Holes were bored in some of the logs and filled with water at regular intervals. The moisture in others was maintained or increased by regular wetting or dipping. The progeny of the beetles placed in the cages were cultured. The wood in 32 of the 39 cages produced beetles infested with *C. ulmi*. The percentages of positive beetles varied from 0 to 74.4. The total number of beetles cultured was 3028, of which 1106, or 36.5 per cent, carried *C. ulmi*. These figures compared favorably with those obtained from cages of diseased wood, as may be seen by reference to data already given.

It was thus shown that under suitable conditions fungus-infested beetles entering healthy wood give rise to spore-bearing progeny, and also that the percentages of these progeny bearing *Ceratostomella ulmi* are comparable to the percentages of spore-bearing beetles which emerge from wood from diseased trees. Observations and field experiments as described below have confirmed this conclusion, and have indicated that uninfected wood may constitute an important factor in the spread of the Dutch elm disease. The pertinent data are assembled under five headings: (1) trap logs, (2) collection stations, (3) naturally occurring uninfected "beetle-wood" (broken limbs, dead trees, and dead parts of living trees containing *Scolytus multistriatus*), (4) woodpiles, (5) relation of beetle-infested uninfected wood to diseased trees.

TRAP LOGS

Each year, beginning in 1935, trap logs of recently cut, healthy American elm have been placed at several locations in and around the disease area for the purpose of attracting elm bark beetles. The logs were 3 to 4 feet in length and usually from 3 to 8 inches in diameter. Ordinarily they were exposed by leaning them against a stone wall, fence, or similar support in a sunny or partly sunny situation. They were placed in position within a day or two after cutting and brought in for examination at varying intervals. Fresh logs were put out each time exposed logs were collected. The regular periods of exposure were 2 weeks, 4 weeks, and 6 weeks. Logs were examined or caged the day after they were collected.

In 1935, a trap-log station was set up in each of three localities: Armonk, Westchester County; Yonkers, Westchester County; and Pelham Bay

Park, the Bronx, New York City. The stations, while in an area of general disease incidence, were not located with reference to specific diseased trees. The Yonkers station was located in the Boyce Thompson Arboretum (called BTA in some of the tables, as distinguished from the Boyce Thompson Farm, BTF, where a station was established later for other purposes). The logs at Armonk and at Yonkers were heavily infested with *Hylurgopinus rufipes* Eich., almost to the complete exclusion of *Scolytus multistriatus*. Only one gallery of the latter species was found and examined at each of these two stations. *S. multistriatus* galleries were very numerous in the logs exposed at Pelham Bay Park. When the bark was removed, the galleries were examined for coremia of *Ceratostomella ulmi*. Coremia were not found in the gallery from Armonk, but were present in the single gallery from Yonkers, and were found in 75, or 4.6 per cent, of the 1605 galleries examined from Pelham Bay Park. Living beetles were found in some of the newer galleries, and a number of them were removed and cultured. The newer galleries were not examined unless they appeared to be old enough to have allowed time for coremia to develop. The total count of galleries, therefore, may include many which were too new to have produced coremia. Of 146 beetles taken from new galleries at Pelham Bay Park in 1935, 9, or 6.1 per cent, were positive for *C. ulmi*. The data mentioned, together with figures supplementing the remarks which follow, are given in table 1.

In 1936, no galleries of *Scolytus multistriatus* were found in the Armonk logs, and only 5 galleries, which were negative, were found at the Yonkers station. At Pelham Bay Park, the beetles were again numerous, and of 730 galleries examined, 21, or 2.9 per cent, contained coremia of *Ceratostomella ulmi*. Of the 219 beetles which were taken from the maternal tunnels, 60, or 27.4 per cent, were positive. The lower half of one of the Pelham Bay Park logs was placed in a cage to await the emergence of the progeny of the beetles that had entered it in the field. In the upper half of this log, coremia had been found in 8 of about 27 galleries examined from different parts of the inner-bark surface. The percentage of galleries containing coremia was approximately the same as for the total number of galleries examined at the same time from the other logs. The log had been cut on June 29, exposed on June 30, brought in on August 25, and examined and caged immediately. Between September 1 and September 24, beetles were emerging and 53 specimens of *S. multistriatus* were collected. Of these, 48 were cultured and 30, or 62.5 per cent, were positive for *C. ulmi*. The log was removed from the cage in October and left on a rack out-of-doors all winter. It was caged again the following spring, and 223 of the 359 beetles which emerged were cultured between June 1 and July 17. Of these, 4, or 1.8 per cent, were positive.

In 1936, eight additional trap-log stations were located at the edge of the known disease area near the stumps of removed diseased trees. At four of these stations *Scolytus multistriatus* entered the logs, and from two of them *Ceratostomella ulmi* was cultured from recently entered beetles (table 1).

In 1937, the galleries were not systematically examined for coremia. However, while the beetle counts were being made, coremia were found in pupal cells and maternal galleries in one of the Pelham Bay Park logs. Half of this log was caged and produced positive beetles.

TABLE 1. RESULTS OF EXAMINING SCOLYTUS MULTISTRIATUS GALLERIES IN TRAP LOGS FOR COREMIA OF CERATOSTOMELLA ULMI; CULTURING RECENTLY ENTERED SPECIMENS OF S. MULTISTRIATUS; AND CULTURING THE EMERGING PROGENY

Location		Year	1. Galleries			2. Recently entered living beetles			3. Emerging progeny of 2		
Town or city	County		Number examined	Number with coremia	Per cent with coremia	Number cultured	Positive		Number cultured	Positive	
							Number	Per cent		Number	Per cent
Armonk	Westchester	1935	1	0	0.0	0	..	...	0	..	...
Yonkers	Westchester	1935	1	1	100.0	0	..	...	0	..	...
Pelham	Bronx	1935	1,605	75	4.6	146	9	6.1	0	..	...
Yonkers	Westchester	1936	5	0	0.0	0	..	...	0	..	...
Pelham	Bronx	1936	730	21	2.9	219	60	27.4	48	30	62.5
Mahopac (1)	Putnam	1936	52	0	0.0	12	0	0.0	0	..	...
Mahopac (2)	Putnam	1936	1	0	0.0	0	..	...	0	..	...
Harriman	Orange	1936	52	0	0.0	23	1	4.4	0	..	...
Monroe	Orange	1936	47	2	4.2	22	2	9.1	0	..	...
Pelham	Westchester	1937	few	few	..	0	..	...	111	4	3.6

The data from the Pelham Bay Park station (called Pelham in the table) for 1936 are the most complete. These point to a significant relationship; namely, that not all spore-bearing beetles which enter healthy logs give rise to fungus-infested colonies, but that the few infested colonies may give rise to spore-bearing beetles in numbers larger than those originally entering. Further evidence of a possible "build-up" of *Ceratostomella ulmi* in healthy logs was obtained from data from the logs placed at the collection stations.

COLLECTION STATIONS

In addition to the regular trap-log stations, after 1936 other stations which were called *collection stations* were set up. In 1937 and 1938, a collection station consisted of a group of healthy elm logs, about 4 feet in length and of varying diameters, set up in the form of a "tepee", with their bases resting on the ground in a small circle and their upper ends leaning against one another. In 1939, at many of the stations, the logs were piled horizontally. A complete list of the stations is given in table 3. The four locations in Westchester County were in the area where the disease was generally prevalent. The stations in Putnam and Dutchess Counties were established at known distances from removed diseased trees. The distance from a station to the nearest diseased tree varied from a few feet to nearly 2 miles (table 3).

Two significant types of records were taken from these collection stations: (1) culture data from beetles collected as they alighted on the logs in the course of their normal free activities; and (2) culture data from the progeny of such beetles, obtained by collecting and culturing specimens that emerged from some of the logs which had been brought in and caged. The only field-collected specimens discussed here are those collected at stations where a culture record was also obtained from some of their progeny emerging from logs brought in and caged. At the time the stations were set up, several of the logs at each station were paraffined to retard drying so that they might be used later as a source of beetles for cul-

turing. These logs were left in the field until nearly time for beetle emergence, then brought in, cut into smaller pieces, paraffined, and caged. In the experiments discussed under the heading "Trap Logs", the logs which were caged were selected because coremia of *Ceratostomella ulmi* had been found in the galleries; the logs discussed under "Collection Stations" were chosen at random. At the time the latter were caged, examinations revealed abundant growth of coremia in maternal tunnels and pupal cells in several of the logs.

Table 2 includes all data obtained from 1937 through 1939 where cultural studies were made both of the entering beetles and of the progeny of the brood which developed in the logs at the stations.

TABLE 2. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS ENTERING HEALTHY ELM WOOD AT COLLECTION STATIONS AND EMERGING FROM THAT WOOD

Location		Beetles				
Town or city	County	Time of collection and culturing	Status of beetles	Number cultured	Number positive	Per cent positive
Yonkers (BTA)	Westchester	Spring, summer, '37	1st brood entering	483	27	5.59
		Summer, fall, '37	Progeny emerging	597	79	13.23
Yonkers (BTF)	Westchester	Summer, '37	2d brood entering	758	7	0.93
		Spring, '38	Progeny emerging	382	237	62.00
Yonkers (BTF)	Westchester	Summer, fall, '38	2d brood entering	225	2	0.88
		Spring, '39	Progeny emerging	348	7	2.05
Ardsley	Westchester	Spring, '39	1st brood entering	38	0	0.00
		Summer, '39	Progeny emerging	59	5	8.47
Tarrytown	Westchester	Spring, '39	1st brood entering	9	1	11.10
		Summer, '39	Progeny emerging	42	1	2.38
Hyde Park	Dutchess	Spring, '39	1st brood entering	122	7	5.74
		Summer, '39	Progeny emerging	71	27	38.01

In 1939 culture records were made of the progeny of beetles which entered logs exposed at several stations where no cultures had been made of the entering beetles. Table 3 includes data obtained in this way from the stations set up that year. The names of the stations which appear also in table 2 are starred in table 3.

TABLE 3. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS EMERGING FROM HEALTHY ELM WOOD FROM COLLECTION STATIONS, SUMMER OF 1939, 2D BROOD EMERGING

Location		Number of beetles cultured	Number of beetles positive	Per cent of beetles positive	Distance to nearest confirmed tree	
Town or city	County				1938	1939
Yonkers (BTF)	Westchester	157	0	0.00	1400 feet	3000 feet
Yonkers (BTA)	Westchester	95	0	0.00	1800 feet	2000 feet
Ardsley*	Westchester	59	5	8.47	1600 feet	1000 feet
Tarrytown*	Westchester	42	1	2.38	200 feet	3500 feet
Patterson	Putnam	23	0	0.00	1¾ miles	1 mile
Schultzeville	Dutchess	218	0	0.00	200 feet	4000 feet
Stanford	Dutchess	76	1	1.31	25 feet	2½ miles
S. Millbrook	Dutchess	3	0	0.00	1 mile	1½ miles
Poughkeepsie	Dutchess	117	2	1.70	4000 feet	2000 feet
Hyde Park*	Dutchess	71	27	38.01	2 feet	1 mile

*See also table 2.

NATURALLY OCCURRING UNINFECTED BEETLE-WOOD

In 1937, in an open field, about one mile from the nearest known diseased tree, a 24-inch elm was found which had been struck by lightning shortly before the first of June. This tree, which was near Washingtonville, in Orange County, was discovered on July 31. Examination and tissue-culturing gave no evidence of infection by *Ceratostomella ulmi*. The branches contained a large number of colonies of *Scolytus multistriatus*. Beetles were both entering and emerging, and were present in all stages. Samples of the wood were brought into the laboratory for beetle emergence. The data obtained are presented in table 4, together with data obtained from other wood as described below.

On August 18, 1938, in Ardsley, Westchester County, a tree which had been killed the preceding year by girdling was found to be heavily infested with *Scolytus multistriatus*, specimens of which were emerging at the time of discovery. This tree was a few feet from a diseased tree which was removed the same day the girdled tree was removed. A portion of the girdled tree was cut up and caged, and beetles emerging were cultured. The data appear in table 4.

TABLE 4. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS EMERGING FROM FIELD-COLLECTED UNINFECTED WOOD

Location		Type of material	Time of collection	Time of beetle emergence and culturing	Beetles		
Town or city	County				Number cultured	Number positive	Per cent positive
Washingtonville	Orange	Lightning-struck	Aug. 1937	Aug. 1937	559	12	2.15
Ardsley	Westchester	Girdled tree	Aug. 1938	Aug. 1938	202	34	16.83
Ghent	Columbia	Lightning-struck	Mar. 1939	May-June, 1939	2	0	0.00
Tivoli	Dutchess	Dead limb	Mar. 1939	May-June, 1939	120	0	0.00
Sharon Station	Dutchess	Dead tree	Mar. 1939	May-June, 1939	98	0	0.00
Poughkeepsie (1)	Dutchess	Windfall	Mar. 1939	May-June, 1939	19	0	0.00
Poughkeepsie (2)	Dutchess	Broken limb	Mar. 1939	May-June, 1939	37	4	10.81
Warwick	Orange	Windfall	Mar. 1939	May-June, 1939	107	0	0.00
Stony Ford	Orange	Broken limb	Mar. 1939	May-June, 1939	66	0	0.00
Little Britain	Orange	Dead tree	Mar. 1939	May-June, 1939	85	6	7.06
Goshen (1)	Orange	Broken limb	Mar. 1939	May-June, 1939	71	1	1.41
Goshen (2)	Orange	Uncertain*	Mar. 1939	May-June, 1939	71	18	25.35
Edenville	Orange	Dead tree	Mar. 1939	May-June, 1939	78	1	1.28

*Material brought in by a field worker and was accompanied by no description of the exact source.

During the month of March in 1939, wood containing overwintering larvae of *Scolytus multistriatus* was collected at several points in the disease area, but without reference to the locations of known diseased trees. The distances to known diseased trees were determined later. The wood came from such material as broken limbs, trees which had been blown down, and trees dead from causes other than the Dutch elm disease. The wood was examined for discoloration which might indicate origin in a diseased tree. If it came from trees which were still partly alive, the living portions were also examined. If any streaking was found, tissue cultures were made. In no instance was *Ceratostomella ulmi* obtained, and it was assumed that none of the wood used was from infected trees. The pieces of wood generally ranged from 4 to 6 inches in diameter. The ends were paraffined and

the wood was stored out-of-doors. On May 8, the material was caged. The results of culturing the emerging beetles are given in table 4.

The locations from which the wood produced no positive beetles varied in distance from 3½ miles to 20 miles from the nearest known diseased tree of the previous year. The sites from which *Ceratostomella ulmi* was obtained were located from a few feet to 2 miles from the nearest confirmed tree of the previous year.

WOODPILES

On August 11, 1938, a considerable amount of elm wood was found in a pile of stovewood on a farm about five miles east of Poughkeepsie. Many pieces of this wood contained larvae and pupae of *Scolytus multistriatus*. On the same day, examination of another pile at Hyde Park revealed similar conditions. The Poughkeepsie woodpile was 1½ miles from the nearest diseased tree found in 1938. The Hyde Park woodpile was about 500 feet from the nearest confirmed tree of 1938. Pieces from each pile were brought in and caged separately. The data obtained from the cages are presented in table 5.

TABLE 5. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS EMERGING FROM WOOD TAKEN FROM WOODPILES IN AUGUST, 1938

Location		Beetles		
Town or city	County	Number cultured	Number positive	Per cent positive
Poughkeepsie	Dutchess	144	1	0.69
Hyde Park	Dutchess	130	0	0.00

The two most common farm methods of storing stovewood are piling it in a more or less open shed and piling it out-of-doors. Experiments were made to determine the relative safety of these two methods of storage with respect to the survival of *Ceratostomella ulmi* and the emergence of beetles carrying the fungus. The experiments involved both diseased wood containing *Scolytus multistriatus* and healthy wood in which spore-bearing beetles had been allowed to breed. In order that normal conditions would obtain, the ends of the logs were not paraffined.

Heavily discolored, beetle-infested, diseased wood was cut into lengths of 15 to 18 inches and distributed among three locations in Orange County. At each location, two piles were made: one inside of a shed, supported off the ground by the lower logs or other supports, and the other outside, piled closely on the ground beside the shed.

The healthy wood was cut into four-foot lengths and stored in a cellar for 18 days, after which it was cut into 15- to 18-inch lengths and caged in the greenhouse with beetles which had been artificially infested with spores of the fungus. After 9 days the logs were taken from the cages and separated into 2 lots. One lot was piled on the wooden floor of a shed at Yonkers and the other was piled outside against the north side of the shed.

In both series of experiments, the wood was left under the described conditions for five or six weeks. It was then brought to the laboratory and caged. The cages of diseased wood were kept out-of-doors on racks

in a large, wire-screen cage. The healthy wood was placed in cages in the greenhouse. Data from these experiments are presented in table 6.

TABLE 6. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS EMERGING FROM SMALL LOGS PILED AS STOVEWOOD, SUMMER, 1939

Location	Description of material	Conditions of storage	Emerging beetles		
			Number cultured	Number positive	Per cent positive
Florida, New York	Field-collected diseased wood containing beetles	(a) In shed (b) Outside shed in shade	99 119	6 5	6.1 4.2
Pine Island	Field-collected diseased wood containing beetles	(a) In shed (b) Outside shed on west side in sun among weeds	135 107	13 18	9.6 16.8
Little York (near Pine Island)	Field-collected diseased wood containing beetles	(a) In shed (b) Outside shed on east side in sun	47 38	2 0	4.3 0.0
Totals	Field-collected diseased wood containing beetles	(a) In sheds (b) Outside sheds	281 264	21 23	7.5 8.7
Yonkers (BTF)	Healthy wood entered by fungus-infested beetles	(a) In shed (b) Outside shed on north side	103 115	20 16	19.4 13.9

It is noted that healthy wood entered by fungus-infested beetles produced a higher percentage of positive specimens than did diseased wood. It was concluded that the storage of untreated, beetle-infested wood out-of-doors or in an ordinary barn or woodshed is unsafe, whether or not the wood is diseased.

RELATION OF BEETLE-INFESTED UNINFECTED WOOD TO DISEASED TREES

When trees in the field are examined at random, feeding by *Scolytus multistriatus* in the twig crotches of living elms appears rather erratic. It was pointed out by Donald L. Collins (1938) that trees adjacent to wood which is either attracting or producing beetles, and trees containing such wood are most likely to be visited for feeding. Since 1938, additional data from laboratory and field experiments and from general observations have indicated that the wood from which beetles are emerging is the more important, since they feed heavily on near-by trees. Wolfenbarger and Buchanan (1939) and Fransen (1939) have made similar observations.

Of the 304 trees confirmed as diseased in the counties of Ulster, Columbia, and Dutchess in 1939, 217 were inspected by members of the laboratory staff to determine the extent of beetle-feeding and the year of infection. The vicinity of each tree was scouted for sources of *Scolytus multistriatus*, and maps were drawn of each site. The number of trees recorded as having become infected during the spring and summer of 1939 was 127.

The approximate time of beetle emergence from a given source, the approximate age of feeding wounds, and the time of infection of diseased trees could usually be determined within reasonable limits. It was ordinarily possible, therefore, to ascertain whether the wounds on a given diseased tree were made by beetles emerging from near-by wood at the proper time to cause that specific infection. In the vicinity of 65 of the 127 trees, a definite beetle source, from which beetles had emerged in the

spring or early summer of 1939, was found within 700 feet. The sources of beetles consisted of dead branches, broken branches (both those still hanging in the tree and those which had fallen to the ground), felled trees, trees blown over by the wind, and woodpiles. In several instances, the source of beetles was located in the diseased tree itself. Sources of this type were in parts of the tree which had broken off or had died before the time of infection, and which had attracted beetles whose progeny fed upon and presumably inoculated the tree. Nearly half of the 65 trees in question had beetle sources of the types described within 25 feet. Figures relative to the diseased trees and beetle sources are presented in table 7.

TABLE 7. LOCATIONS OF SOURCES OF SCOLYTUS MULTISTRIATUS IN UNINFECTED WOOD WITH REFERENCE TO LOCATIONS OF DISEASED TREES IN 1939

Description of diseased tree	Number of trees within specified distances of beetle sources in uninfected wood			
	650 feet	500 feet	100 feet	In or under tree or within 25 feet
Single	27	26	18	16
In groups of 2 or more	38	36	23	13
Total	65	62	41	29

Of the remaining 62 trees, not included in table 7, which were inspected and judged to constitute 1939 infections, all but two occurred singly; that is, they were not associated with other diseased trees. These 62 trees are considered separately because they were not definitely related to beetle material from which it could be determined that emergence had taken place in the spring of 1939. Nearly all of them, however, were in swamps or in other unfavorable situations, and usually there was a considerable amount of dead wood in the vicinity. Much of this dead wood was inaccessible for close observation, but in most instances evidence of the presence of *Scolytus multistriatus* was found.

There were a few sites where no sources of *Scolytus multistriatus* could be found in the immediate vicinity of the diseased tree, but where there were sources of *Hylurgopinus rufipes* within 500 feet. *Scolytus sulcatus* LeC. was found not infrequently breeding in or near diseased trees.

With the exception of one group of 2 trees, whenever 2 or more diseased trees were found associated with one another, a source of *Scolytus multistriatus* was definitely established. Thus, a total of 40 trees with 1939 infections were found in groups of 2 to 7 trees, and, as may be noted in table 7, 38 of the 40 trees were definitely associated with a source of beetles. From these observations, it appeared that wherever a number of trees were inoculated by beetles from the same source, that source was usually large and easily found.

An example of what can happen when beetles are allowed to build up a heavy population in a limited area was seen in a swamp near Kingston during March, 1940. A low area adjacent to a small pond had a large elm population including trees of all diameters up to about 25 inches. The area was roughly 500 feet long by 300 feet wide. Sometime prior to 1939 the area had been flooded, resulting in the death of many trees, which became infested by *Scolytus multistriatus*. Emergence in large numbers

from these trees first took place in the spring of 1939, and the beetles fed heavily on the adjacent trees during that period. Nearly all of the living trees were sampled and 33 were confirmed. No confirmed tree was more than 100 feet distant from a beetle source, from which beetles had emerged in the spring of 1939, and all of the infections had occurred during that period.

In the instances cited usually no opportunity was offered for culturing the suspected beetles, since they had fed and disappeared by the time the diseased trees were seen and removed. Such an opportunity occurred in one case, however, when a broken branch on an uninfected tree near Poughkeepsie was found to contain colonies of *Scolytus multistriatus* in March, 1939 (Poughkeepsie (2) in table 4). A section of the limb was brought in, and from this section 37 beetles, which emerged in May and June, were cultured. Of these, 4, or 10.8 per cent, were positive. In the meantime, the rest of this limb, which had been left as it was found, was producing beetles, as evidenced by subsequent examination. During the summer, a tree about 50 feet distant became infected with the Dutch elm disease. The nearest confirmed tree the previous season had been a mile away. The circumstances inevitably suggest the cause-and-effect relationship assumed with respect to the trees mentioned above as being associated with known beetle sources.

SUMMARY AND CONCLUSIONS

As high as 15 per cent of the specimens of *Scolytus multistriatus* collected in the field in southeastern New York State were found, by culturing, to be carrying the Dutch elm disease pathogen *Ceratostomella ulmi*. When cultured directly after emerging from diseased wood, as high as 100 per cent of the beetles were positive for *C. ulmi*, but usually they averaged considerably less than 50.

When beetles were artificially infested with spores and allowed to enter healthy wood, as high as 74 per cent of their progeny emerged carrying spores of *Ceratostomella ulmi*. Healthy cut logs exposed to normal beetle attack in the field produced as high as 62 per cent of positive beetles in the progeny of parents which probably averaged much lower when entering. Pieces of uninfected beetle-wood found in the field produced as high as 25 per cent of positive beetles.

Uninfected elm wood in farmers' woodpiles also produced positive beetles. Diseased wood cut in short lengths and piled produced as high as 16 per cent of positive beetles when stored out-of-doors and as high as 9 per cent when stored in sheds. Healthy wood cut and stored in a similar way, but subjected to entry by spore-bearing beetles, produced 14 per cent of positive beetles when stored out-of-doors and 19 per cent when stored in a shed.

In 1939, in the counties of Ulster, Columbia, and Dutchess, that is, in the peripheral regions of the disease area, 217 of the 304 confirmed trees were inspected. Of these, 127 were recorded as having become infected in 1939. In the vicinity of 65 of these trees, uninfected wood which had produced *Scolytus multistriatus* in the spring or early summer of 1939 was discovered. In these instances there appeared to be a definite correlation of beetle emergence and beetle feeding with the probable time of infection.

This led to the inference that the disease pathogen was communicated to these trees by beetles which had emerged from uninfected wood. Whether this inference is justified in every instance, it was shown that uninfected wood can, and often does, produce beetles which carry inoculum. Dead or dying elm wood of whatever origin, if suitable for the breeding of *Scolytus multistriatus*, is therefore a potential source of inoculum from which the Dutch elm disease pathogen may be spread by emerging beetles. Since the beetles can carry the fungus into uninfected wood, and their progeny can carry it out, such wood serves as a reservoir for continuing local dissemination of the disease organism. It may also act as a bridge for the transfer of the fungus from the disease area to regions where the disease does not occur.

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Uninfected Elm Wood as a Source of the Bark Beetle (*Scolytus multistriatus* Marsham) Carrying the Dutch Elm Disease Pathogen

Donald L. Collins, K. G. Parker, and Henry Dietrich

THE WOODPILE, A BREEDING PLACE OF THE BARK BEETLE
Beetles emerging from the elm wood in the woodpile probably inoculated the adjacent elm tree

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UNINFECTED ELM WOOD AS A SOURCE OF THE BARK BEETLE (*SCOLYTUS MULTISTRIATUS* MARSHAM) CARRYING THE DUTCH ELM DISEASE PATHOGEN

Donald L. Collins, K. G. Parker, and Henry Dietrich[1]

It has been known for several years that bark beetles of the family Scolytidae may carry the Dutch elm disease pathogen, *Ceratostomella ulmi* (Schwarz) Buisman, presumably, for the most part, in the form of spores. Fransen (1939) gives Marchal[2] credit for having been the first to suggest that elm bark beetles were concerned in the transmission of the Dutch elm disease organism. Wollenweber and Stapp (1928), having seen *C. ulmi* in the pupal cells of *Scolytus scolytus* Fabricius, also suggested the relationship between these bark beetles and the fungus. In Europe this relationship has been confirmed by Fransen (1931) and by Fransen and Buisman (1935), not only for *S. scolytus* but also for *Scolytus multistriatus* Marsham. In the United States transmission of the fungus by *S. multistriatus* from infected wood to healthy elms was described by Middleton, Buchanan, May, and Walter in 1935. *S. multistriatus* is now generally considered to be the most effective agent in the transmission of this fungus in the United States.

In order to determine what percentage of beetles in the field were actually carrying inoculum, many specimens of *Scolytus multistriatus* were collected and cultured. They were taken at felled, healthy trees as they alighted for entry, at dead trees which had died from causes other than the Dutch elm disease, at broken branches of uninfected trees, and at piles of freshly cut, healthy elm logs set up to attract them. The percentages of "positive" beetles (beetles from which *Ceratostomella ulmi* was obtained) varied widely from year to year and from locality to locality. In 1935, in the Bronx, New York City, which was at that time in an area of heavy disease incidence, 15 per cent of the 411 specimens of *S. multistriatus* that were collected and cultured were positive. In 1936, from Bronx, Westchester, and Rockland Counties, 7.6 per cent of 688 specimens were positive. In 1937, in Westchester County, 2.9 per cent of 3618 specimens were positive. In 1938, of 225 specimens collected in Yonkers (Westchester County) only 2, or 0.9 per cent, were positive; while in 1939, at Tarrytown, 1 of 9 specimens, and at Hyde Park (Dutchess County), 7 of 122 specimens (percentages of 11.10 and 5.74 respectively) were positive.

When beetles in the disease area carry inoculum to the extent indicated, their origin or source becomes a question of importance. It has already been noted that specimens emerging from wood from diseased trees can carry the spores of the fungus. An idea of the number of beetles carrying the fungus at the time they emerged from such material was gained from

several experiments. Wood from diseased elms which contained colonies of *Scolytus multistriatus* was brought into the laboratory and beetles which emerged from it were cultured. For this purpose, wood which had considerable discoloration in the outermost growth ring, or wood in which coremia of the fungus were found in the pupal cells of the beetles, was chosen. The standard method adopted for treating such wood was to cut it into 20-inch lengths, coat both ends and any other points where wood was exposed with paraffin to retard drying, and place it in small cages. If the beetles were in the pupal stage the wood was cut up and caged immediately after collection. If the beetles had entered only a short time before collection, the wood was usually left in longer pieces. Just before emergence was expected, the wood was cut up and caged. A few inches at each end of the log, where drying was most rapid, were usually discarded. The percentages of emerging beetles carrying spores out of the wood in the several cages varied from 0 to 100. The fungus infestation of the beetles was influenced by the condition of the wood, the extent of the fungus invasion at the time of collection, and the temperature and moisture conditions under which the wood was kept.

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[1] Professor P. A. Readio initiated some of the experiments described in this paper and developed certain techniques used in handling the beetles. Dr. W. H. Rankin, supervisor of Dutch Elm Disease Control of the New York State Department of Agriculture and Markets, and members of his staff, coöperated to the fullest extent, especially in locating beetle material and in facilitating the field observations on diseased trees. Acknowledgment is also due the Boyce Thompson Institute for Plant Research, where the Cornell University Laboratory for Dutch Elm Disease Investigations is located, for coöperation and assistance. Other members of the laboratory staff who had a considerable share in the investigations reported here were Seth Pope, L. L. Pechuman, and L. J. Tyler.

[2] Marchal, E. Rapport sur les résultats des recherches effectuées à la Station de Phyt. de l'État à Gembloux, sur la maladie de l'orme. Soc. Centr. Forest. Belgique. Bul. 35: 162–164. 1927.

Culture records of the progeny of uninfested beetles which were allowed to enter diseased wood in the laboratory or greenhouse also indicated that constancy could not be expected in the numbers of spore-bearing beetles emerging from diseased wood. After entry of the beetles, special treatments, such as dipping the logs in water at regular intervals, boring holes in the ends and sides and keeping them filled with water, and the maintenance of high humidity in the storage chambers, produced results which sometimes varied with the treatments and sometimes independently of them. The highest percentage of positive beetles in the experiments carried out in 1935–36 was 44, with an average of less than 6 in the remaining cages. In 1936–37, the highest percentage of positive beetles from any one cage was 81.8. In these experiments, wood from 4 different sources produced beetles which averaged 41 per cent positive of the 1820 cultured from all cages. Similar variations undoubtedly occur as a result of analogous but uncontrolled and often unknown conditions in the field.

C. W. Collins and his associates (1936) found that beetles could obtain inoculum by feeding in twig crotches of diseased trees, and could transfer it to the brood galleries which they subsequently made. At the Cornell University laboratory in Yonkers, beetles were disinfested externally and allowed to feed on badly wilted, diseased trees. Of the 121 beetles which were alive when removed after feeding two or three days, 15, or 12.4 per cent, were shown by culturing to have acquired inoculum. Cultures of beetles from the same lot, which had not fed on diseased trees, produced no growth of *Ceratostomella ulmi*.

C. W. Collins and his associates also found that beetles emerging from diseased wood could transfer the disease organism to their brood galleries, and reported a number of instances in the field where the fungus was growing in galleries of beetles which had entered uninfected[3] wood. Fransen (1931) recorded coremia growing in pupal cells of *Scolytus scolytus*, and observed that beetles could bring the fungus into the bark by introducing it

into their egg tunnels. The authors of this bulletin have often found dead trees and woodpiles near diseased trees, with evidence that *Scolytus multistriatus* had emerged in great numbers, and in several instances with coremia of *Ceratostomella ulmi* not only in the maternal galleries but also in the pupal cells.

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[3] The term *uninfected* is used in this paper to refer to wood or trees in which, as far as could be determined, there had been no infection by *Ceratostomella ulmi* prior to the death or cutting of the tree or branch involved.

EXPERIMENTS

Observations such as these led to the suspicion that woodpiles and other breeding-wood originating in uninfected trees might have given rise to some of the fungus-infested beetles found in the field. In laboratory experiments, beetles were disinfested to render them less likely to contaminate their galleries with unwanted bacteria and fungi and were then allowed to walk for several hours over coremia of *Ceratostomella ulmi* growing in pure culture on elm twigs. At the end of this period, the most active beetles were selected and placed in cages containing healthy elm logs cut into 20-inch lengths. For experimental purposes the cages were kept under widely different conditions of temperature and humidity. Holes were bored in some of the logs and filled with water at regular intervals. The moisture in others was maintained or increased by regular wetting or dipping. The progeny of the beetles placed in the cages were cultured. The wood in 32 of the 39 cages produced beetles infested with *C. ulmi*. The percentages of positive beetles varied from 0 to 74.4. The total number of beetles cultured was 3028, of which 1106, or 36.5 per cent, carried *C. ulmi*. These figures compared favorably with those obtained from cages of diseased wood, as may be seen by reference to data already given.

It was thus shown that under suitable conditions fungus-infested beetles entering healthy wood give rise to spore-bearing progeny, and also that the percentages of these progeny bearing *Ceratostomella ulmi* are comparable to the percentages of spore-bearing beetles which emerge from wood from diseased trees. Observations and field experiments as described below have confirmed this conclusion, and have indicated that uninfected wood may constitute an important factor in the spread of the Dutch elm disease. The pertinent data are assembled under five headings: (1) trap logs, (2) collection stations, (3) naturally occurring uninfected "beetle-wood" (broken limbs, dead trees, and dead parts of living trees containing *Scolytus multistriatus*), (4) woodpiles, (5) relation of beetle-infested uninfected wood to diseased trees.

TRAP LOGS

Each year, beginning in 1935, trap logs of recently cut, healthy American elm have been placed at several locations in and around the disease area for the purpose of attracting elm bark beetles. The logs were 3 to 4 feet in length and usually from 3 to 8 inches in diameter. Ordinarily they were exposed by leaning them against a stone wall, fence, or similar support in a sunny or partly sunny situation. They were placed in position within a day or two after cutting and brought in for examination at varying intervals. Fresh logs were put out each time exposed logs were collected. The regular periods of exposure were 2 weeks, 4 weeks, and 6 weeks. Logs were examined or caged the day after they were collected.

In 1935, a trap-log station was set up in each of three localities: Armonk, Westchester County; Yonkers, Westchester County; and Pelham Bay

Park, the Bronx, New York City. The stations, while in an area of general disease incidence, were not located with reference to specific diseased trees. The Yonkers station was located in the Boyce Thompson Arboretum (called BTA in some of the tables, as distinguished from the Boyce Thompson Farm, BTF, where a station was established later for other purposes). The logs at Armonk and at Yonkers were heavily infested with *Hylurgopinus rufipes* Eich., almost to the complete exclusion of *Scolytus multistriatus*. Only one gallery of the latter species was found and examined at each of these two stations. *S. multistriatus* galleries were very numerous in the logs exposed at Pelham Bay Park. When the bark was removed, the galleries were examined for coremia of *Ceratostomella ulmi*. Coremia were not found in the gallery from Armonk, but were present in the single gallery from Yonkers, and were found in 75, or 4.6 per cent, of the 1605 galleries examined from Pelham Bay Park. Living beetles were found in some of the newer galleries, and a number of them were removed and cultured. The newer galleries were not examined unless they appeared to be old enough to have allowed time for coremia to develop. The total count of galleries, therefore, may include many which were too new to have produced coremia. Of 146 beetles taken from new galleries at Pelham Bay Park in 1935, 9, or 6.1 per cent, were positive for *C. ulmi*. The data mentioned, together with figures supplementing the remarks which follow, are given in table 1.

In 1936, no galleries of *Scolytus multistriatus* were found in the Armonk logs, and only 5 galleries, which were negative, were found at the Yonkers station. At Pelham Bay Park, the beetles were again numerous, and of 730 galleries examined, 21, or 2.9 per cent, contained coremia of *Ceratostomella ulmi*. Of the 219 beetles which were taken from the maternal tunnels, 60, or 27.4 per cent, were positive. The lower half of one of the Pelham Bay Park logs was placed in a cage to await the emergence of the progeny of the beetles that had entered it in the field. In the upper half of this log, coremia had been found in 8 of about 27 galleries examined from different parts of the inner-bark surface. The percentage of galleries containing coremia was approximately the same as for the total number of galleries examined at the same time from the other logs. The log had been cut on June 29, exposed on June 30, brought in on August 25, and examined and caged immediately. Between September 1 and September 24, beetles were emerging and 53 specimens of *S. multistriatus* were collected. Of these, 48 were cultured and 30, or 62.5 per cent, were positive for *C. ulmi*. The log was removed from the cage in October and left on a rack out-of-doors all winter. It was caged again the following spring, and 223 of the 359 beetles which emerged were cultured between June 1 and July 17. Of these, 4, or 1.8 per cent, were positive.

In 1936, eight additional trap-log stations were located at the edge of the known disease area near the stumps of removed diseased trees. At four of these stations *Scolytus multistriatus* entered the logs, and from two of them *Ceratostomella ulmi* was cultured from recently entered beetles (table 1).

In 1937, the galleries were not systematically examined for coremia. However, while the beetle counts were being made, coremia were found in pupal cells and maternal galleries in one of the Pelham Bay Park logs. Half of this log was caged and produced positive beetles.

TABLE 1. RESULTS OF EXAMINING SCOLYTUS MULTISTRIATUS GALLERIES IN TRAP LOGS FOR COREMIA OF CERATOSTOMELLA ULMI; CULTURING RECENTLY ENTERED SPECIMENS OF S. MULTISTRIATUS; AND CULTURING THE EMERGING PROGENY

Location		Year	1. Galleries			2. Recently entered living beetles			3. Emerging progeny of 2		
Town or city	County		Number examined	Number with coremia	Per cent with coremia	Number cultured	Positive		Number cultured	Positive	
							Number	Per cent		Number	Per cent
Armonk	Westchester	1935	1	0	0.0	0	..	...	0	..	...
Yonkers	Westchester	1935	1	1	100.0	0	..	...	0	..	...
Pelham	Bronx	1935	1,605	75	4.6	146	9	6.1	0	..	...
Yonkers	Westchester	1936	5	0	0.0	0	..	...	0	..	...
Pelham	Bronx	1936	730	21	2.9	219	60	27.4	48	30	62.5
Mahopac (1)	Putnam	1936	52	0	0.0	12	0	0.0	0	..	...
Mahopac (2)	Putnam	1936	1	0	0.0	0	..	...	0	..	...
Harriman	Orange	1936	52	0	0.0	23	1	4.4	0	..	...
Monroe	Orange	1936	47	2	4.2	22	2	9.1	0	..	...
Pelham	Westchester	1937	few	few	..	0	..	...	111	4	3.6

The data from the Pelham Bay Park station (called Pelham in the table) for 1936 are the most complete. These point to a significant relationship; namely, that not all spore-bearing beetles which enter healthy logs give rise to fungus-infested colonies, but that the few infested colonies may give rise to spore-bearing beetles in numbers larger than those originally entering. Further evidence of a possible "build-up" of *Ceratostomella ulmi* in healthy logs was obtained from data from the logs placed at the collection stations.

COLLECTION STATIONS

In addition to the regular trap-log stations, after 1936 other stations which were called *collection stations* were set up. In 1937 and 1938, a collection station consisted of a group of healthy elm logs, about 4 feet in length and of varying diameters, set up in the form of a "tepee", with their bases resting on the ground in a small circle and their upper ends leaning against one another. In 1939, at many of the stations, the logs were piled horizontally. A complete list of the stations is given in table 3. The four locations in Westchester County were in the area where the disease was generally prevalent. The stations in Putnam and Dutchess Counties were established at known distances from removed diseased trees. The distance from a station to the nearest diseased tree varied from a few feet to nearly 2 miles (table 3).

Two significant types of records were taken from these collection stations: (1) culture data from beetles collected as they alighted on the logs in the course of their normal free activities; and (2) culture data from the progeny of such beetles, obtained by collecting and culturing specimens that emerged from some of the logs which had been brought in and caged. The only field-collected specimens discussed here are those collected at stations where a culture record was also obtained from some of their progeny emerging from logs brought in and caged. At the time the stations were set up, several of the logs at each station were paraffined to retard drying so that they might be used later as a source of beetles for cul-

turing. These logs were left in the field until nearly time for beetle emergence, then brought in, cut into smaller pieces, paraffined, and caged. In the experiments discussed under the heading "Trap Logs", the logs which were caged were selected because coremia of *Ceratostomella ulmi* had been found in the galleries; the logs discussed under "Collection Stations" were chosen at random. At the time the latter were caged, examinations revealed abundant growth of coremia in maternal tunnels and pupal cells in several of the logs.

Table 2 includes all data obtained from 1937 through 1939 where cultural studies were made both of the entering beetles and of the progeny of the brood which developed in the logs at the stations.

TABLE 2. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS ENTERING HEALTHY ELM WOOD AT COLLECTION STATIONS AND EMERGING FROM THAT WOOD

Location		Beetles				
Town or city	County	Time of collection and culturing	Status of beetles	Number cultured	Number positive	Per cent positive
Yonkers (BTA)	Westchester	Spring, summer, '37	1st brood entering	483	27	5.59
		Summer, fall, '37	Progeny emerging	597	79	13.23
Yonkers (BTF)	Westchester	Summer, '37	2d brood entering	758	7	0.93
		Spring, '38	Progeny emerging	382	237	62.00
Yonkers (BTF)	Westchester	Summer, fall, '38	2d brood entering	225	2	0.88
		Spring, '39	Progeny emerging	348	7	2.05
Ardsley	Westchester	Spring, '39	1st brood entering	38	0	0.00
		Summer, '39	Progeny emerging	59	5	8.47
Tarrytown	Westchester	Spring, '39	1st brood entering	9	1	11.10
		Summer, '39	Progeny emerging	42	1	2.38
Hyde Park	Dutchess	Spring, '39	1st brood entering	122	7	5.74
		Summer, '39	Progeny emerging	71	27	38.01

In 1939 culture records were made of the progeny of beetles which entered logs exposed at several stations where no cultures had been made of the entering beetles. Table 3 includes data obtained in this way from the stations set up that year. The names of the stations which appear also in table 2 are starred in table 3.

TABLE 3. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS EMERGING FROM HEALTHY ELM WOOD FROM COLLECTION STATIONS, SUMMER OF 1939, 2D BROOD EMERGING

Location		Number of beetles cultured	Number of beetles positive	Per cent of beetles positive	Distance to nearest confirmed tree	
Town or city	County				1938	1939
Yonkers (BTF)	Westchester	157	0	0.00	1400 feet	3000 feet
Yonkers (BTA)	Westchester	95	0	0.00	1800 feet	2000 feet
Ardsley*	Westchester	59	5	8.47	1600 feet	1000 feet
Tarrytown*	Westchester	42	1	2.38	200 feet	3500 feet
Patterson	Putnam	23	0	0.00	1¾ miles	1 mile
Schultzeville	Dutchess	218	0	0.00	200 feet	4000 feet
Stanford	Dutchess	76	1	1.31	25 feet	2½ miles
S. Millbrook	Dutchess	3	0	0.00	1 mile	1½ miles
Poughkeepsie	Dutchess	117	2	1.70	4000 feet	2000 feet
Hyde Park*	Dutchess	71	27	38.01	2 feet	1 mile

*See also table 2.

NATURALLY OCCURRING UNINFECTED BEETLE-WOOD

In 1937, in an open field, about one mile from the nearest known diseased tree, a 24-inch elm was found which had been struck by lightning shortly before the first of June. This tree, which was near Washingtonville, in Orange County, was discovered on July 31. Examination and tissue-culturing gave no evidence of infection by *Ceratostomella ulmi*. The branches contained a large number of colonies of *Scolytus multistriatus*. Beetles were both entering and emerging, and were present in all stages. Samples of the wood were brought into the laboratory for beetle emergence. The data obtained are presented in table 4, together with data obtained from other wood as described below.

On August 18, 1938, in Ardsley, Westchester County, a tree which had been killed the preceding year by girdling was found to be heavily infested with *Scolytus multistriatus*, specimens of which were emerging at the time of discovery. This tree was a few feet from a diseased tree which was removed the same day the girdled tree was removed. A portion of the girdled tree was cut up and caged, and beetles emerging were cultured. The data appear in table 4.

TABLE 4. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS EMERGING FROM FIELD-COLLECTED UNINFECTED WOOD

Location		Type of material	Time of collection	Time of beetle emergence and culturing	Beetles		
Town or city	County				Number cultured	Number positive	Per cent positive
Washingtonville	Orange	Lightning-struck	Aug. 1937	Aug. 1937	559	12	2.15
Ardsley	Westchester	Girdled tree	Aug. 1938	Aug. 1938	202	34	16.83
Ghent	Columbia	Lightning-struck	Mar. 1939	May-June, 1939	2	0	0.00
Tivoli	Dutchess	Dead limb	Mar. 1939	May-June, 1939	120	0	0.00
Sharon Station	Dutchess	Dead tree	Mar. 1939	May-June, 1939	98	0	0.00
Poughkeepsie (1)	Dutchess	Windfall	Mar. 1939	May-June, 1939	19	0	0.00
Poughkeepsie (2)	Dutchess	Broken limb	Mar. 1939	May-June, 1939	37	4	10.81
Warwick	Orange	Windfall	Mar. 1939	May-June, 1939	107	0	0.00
Stony Ford	Orange	Broken limb	Mar. 1939	May-June, 1939	66	0	0.00
Little Britain	Orange	Dead tree	Mar. 1939	May-June, 1939	85	6	7.06
Goshen (1)	Orange	Broken limb	Mar. 1939	May-June, 1939	71	1	1.41
Goshen (2)	Orange	Uncertain*	Mar. 1939	May-June, 1939	71	18	25.35
Edenville	Orange	Dead tree	Mar. 1939	May-June, 1939	78	1	1.28

*Material brought in by a field worker and was accompanied by no description of the exact source.

During the month of March in 1939, wood containing overwintering larvae of *Scolytus multistriatus* was collected at several points in the disease area, but without reference to the locations of known diseased trees. The distances to known diseased trees were determined later. The wood came from such material as broken limbs, trees which had been blown down, and trees dead from causes other than the Dutch elm disease. The wood was examined for discoloration which might indicate origin in a diseased tree. If it came from trees which were still partly alive, the living portions were also examined. If any streaking was found, tissue cultures were made. In no instance was *Ceratostomella ulmi* obtained, and it was assumed that none of the wood used was from infected trees. The pieces of wood generally ranged from 4 to 6 inches in diameter. The ends were paraffined and

the wood was stored out-of-doors. On May 8, the material was caged. The results of culturing the emerging beetles are given in table 4.

The locations from which the wood produced no positive beetles varied in distance from 3½ miles to 20 miles from the nearest known diseased tree of the previous year. The sites from which *Ceratostomella ulmi* was obtained were located from a few feet to 2 miles from the nearest confirmed tree of the previous year.

WOODPILES

On August 11, 1938, a considerable amount of elm wood was found in a pile of stovewood on a farm about five miles east of Poughkeepsie. Many pieces of this wood contained larvae and pupae of *Scolytus multistriatus*. On the same day, examination of another pile at Hyde Park revealed similar conditions. The Poughkeepsie woodpile was 1½ miles from the nearest diseased tree found in 1938. The Hyde Park woodpile was about 500 feet from the nearest confirmed tree of 1938. Pieces from each pile were brought in and caged separately. The data obtained from the cages are presented in table 5.

TABLE 5. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS EMERGING FROM WOOD TAKEN FROM WOODPILES IN AUGUST, 1938

Location		Beetles		
Town or city	County	Number cultured	Number positive	Per cent positive
Poughkeepsie	Dutchess	144	1	0.69
Hyde Park	Dutchess	130	0	0.00

The two most common farm methods of storing stovewood are piling it in a more or less open shed and piling it out-of-doors. Experiments were made to determine the relative safety of these two methods of storage with respect to the survival of *Ceratostomella ulmi* and the emergence of beetles carrying the fungus. The experiments involved both diseased wood containing *Scolytus multistriatus* and healthy wood in which spore-bearing beetles had been allowed to breed. In order that normal conditions would obtain, the ends of the logs were not paraffined.

Heavily discolored, beetle-infested, diseased wood was cut into lengths of 15 to 18 inches and distributed among three locations in Orange County. At each location, two piles were made: one inside of a shed, supported off the ground by the lower logs or other supports, and the other outside, piled closely on the ground beside the shed.

The healthy wood was cut into four-foot lengths and stored in a cellar for 18 days, after which it was cut into 15- to 18-inch lengths and caged in the greenhouse with beetles which had been artificially infested with spores of the fungus. After 9 days the logs were taken from the cages and separated into 2 lots. One lot was piled on the wooden floor of a shed at Yonkers and the other was piled outside against the north side of the shed.

In both series of experiments, the wood was left under the described conditions for five or six weeks. It was then brought to the laboratory and caged. The cages of diseased wood were kept out-of-doors on racks

in a large, wire-screen cage. The healthy wood was placed in cages in the greenhouse. Data from these experiments are presented in table 6.

TABLE 6. RESULTS OF CULTURING SCOLYTUS MULTISTRIATUS EMERGING FROM SMALL LOGS PILED AS STOVEWOOD, SUMMER, 1939

Location	Description of material	Conditions of storage	Emerging beetles		
			Number cultured	Number positive	Per cent positive
Florida, New York	Field-collected diseased wood containing beetles	(a) In shed (b) Outside shed in shade	99 119	6 5	6.1 4.2
Pine Island	Field-collected diseased wood containing beetles	(a) In shed (b) Outside shed on west side in sun among weeds	135 107	13 18	9.6 16.8
Little York (near Pine Island)	Field-collected diseased wood containing beetles	(a) In shed (b) Outside shed on east side in sun	47 38	2 0	4.3 0.0
Totals	Field-collected diseased wood containing beetles	(a) In sheds (b) Outside sheds	281 264	21 23	7.5 8.7
Yonkers (BTF)	Healthy wood entered by fungus-infested beetles	(a) In shed (b) Outside shed on north side	103 115	20 16	19.4 13.9

It is noted that healthy wood entered by fungus-infested beetles produced a higher percentage of positive specimens than did diseased wood. It was concluded that the storage of untreated, beetle-infested wood out-of-doors or in an ordinary barn or woodshed is unsafe, whether or not the wood is diseased.

RELATION OF BEETLE-INFESTED UNINFECTED WOOD TO DISEASED TREES

When trees in the field are examined at random, feeding by *Scolytus multistriatus* in the twig crotches of living elms appears rather erratic. It was pointed out by Donald L. Collins (1938) that trees adjacent to wood which is either attracting or producing beetles, and trees containing such wood are most likely to be visited for feeding. Since 1938, additional data from laboratory and field experiments and from general observations have indicated that the wood from which beetles are emerging is the more important, since they feed heavily on near-by trees. Wolfenbarger and Buchanan (1939) and Fransen (1939) have made similar observations.

Of the 304 trees confirmed as diseased in the counties of Ulster, Columbia, and Dutchess in 1939, 217 were inspected by members of the laboratory staff to determine the extent of beetle-feeding and the year of infection. The vicinity of each tree was scouted for sources of *Scolytus multistriatus*, and maps were drawn of each site. The number of trees recorded as having become infected during the spring and summer of 1939 was 127.

The approximate time of beetle emergence from a given source, the approximate age of feeding wounds, and the time of infection of diseased trees could usually be determined within reasonable limits. It was ordinarily possible, therefore, to ascertain whether the wounds on a given diseased tree were made by beetles emerging from near-by wood at the proper time to cause that specific infection. In the vicinity of 65 of the 127 trees, a definite beetle source, from which beetles had emerged in the

spring or early summer of 1939, was found within 700 feet. The sources of beetles consisted of dead branches, broken branches (both those still hanging in the tree and those which had fallen to the ground), felled trees, trees blown over by the wind, and woodpiles. In several instances, the source of beetles was located in the diseased tree itself. Sources of this type were in parts of the tree which had broken off or had died before the time of infection, and which had attracted beetles whose progeny fed upon and presumably inoculated the tree. Nearly half of the 65 trees in question had beetle sources of the types described within 25 feet. Figures relative to the diseased trees and beetle sources are presented in table 7.

TABLE 7. LOCATIONS OF SOURCES OF SCOLYTUS MULTISTRIATUS IN UNINFECTED WOOD WITH REFERENCE TO LOCATIONS OF DISEASED TREES IN 1939

Description of diseased tree	Number of trees within specified distances of beetle sources in uninfected wood			
	650 feet	500 feet	100 feet	In or under tree or within 25 feet
Single	27	26	18	16
In groups of 2 or more	38	36	23	13
Total	65	62	41	29

Of the remaining 62 trees, not included in table 7, which were inspected and judged to constitute 1939 infections, all but two occurred singly; that is, they were not associated with other diseased trees. These 62 trees are considered separately because they were not definitely related to beetle material from which it could be determined that emergence had taken place in the spring of 1939. Nearly all of them, however, were in swamps or in other unfavorable situations, and usually there was a considerable amount of dead wood in the vicinity. Much of this dead wood was inaccessible for close observation, but in most instances evidence of the presence of *Scolytus multistriatus* was found.

There were a few sites where no sources of *Scolytus multistriatus* could be found in the immediate vicinity of the diseased tree, but where there were sources of *Hylurgopinus rufipes* within 500 feet. *Scolytus sulcatus* LeC. was found not infrequently breeding in or near diseased trees.

With the exception of one group of 2 trees, whenever 2 or more diseased trees were found associated with one another, a source of *Scolytus multistriatus* was definitely established. Thus, a total of 40 trees with 1939 infections were found in groups of 2 to 7 trees, and, as may be noted in table 7, 38 of the 40 trees were definitely associated with a source of beetles. From these observations, it appeared that wherever a number of trees were inoculated by beetles from the same source, that source was usually large and easily found.

An example of what can happen when beetles are allowed to build up a heavy population in a limited area was seen in a swamp near Kingston during March, 1940. A low area adjacent to a small pond had a large elm population including trees of all diameters up to about 25 inches. The area was roughly 500 feet long by 300 feet wide. Sometime prior to 1939 the area had been flooded, resulting in the death of many trees, which became infested by *Scolytus multistriatus*. Emergence in large numbers

from these trees first took place in the spring of 1939, and the beetles fed heavily on the adjacent trees during that period. Nearly all of the living trees were sampled and 33 were confirmed. No confirmed tree was more than 100 feet distant from a beetle source, from which beetles had emerged in the spring of 1939, and all of the infections had occurred during that period.

In the instances cited usually no opportunity was offered for culturing the suspected beetles, since they had fed and disappeared by the time the diseased trees were seen and removed. Such an opportunity occurred in one case, however, when a broken branch on an uninfected tree near Poughkeepsie was found to contain colonies of *Scolytus multistriatus* in March, 1939 (Poughkeepsie (2) in table 4). A section of the limb was brought in, and from this section 37 beetles, which emerged in May and June, were cultured. Of these, 4, or 10.8 per cent, were positive. In the meantime, the rest of this limb, which had been left as it was found, was producing beetles, as evidenced by subsequent examination. During the summer, a tree about 50 feet distant became infected with the Dutch elm disease. The nearest confirmed tree the previous season had been a mile away. The circumstances inevitably suggest the cause-and-effect relationship assumed with respect to the trees mentioned above as being associated with known beetle sources.

SUMMARY AND CONCLUSIONS

As high as 15 per cent of the specimens of *Scolytus multistriatus* collected in the field in southeastern New York State were found, by culturing, to be carrying the Dutch elm disease pathogen *Ceratostomella ulmi*. When cultured directly after emerging from diseased wood, as high as 100 per cent of the beetles were positive for *C. ulmi*, but usually they averaged considerably less than 50.

When beetles were artificially infested with spores and allowed to enter healthy wood, as high as 74 per cent of their progeny emerged carrying spores of *Ceratostomella ulmi*. Healthy cut logs exposed to normal beetle attack in the field produced as high as 62 per cent of positive beetles in the progeny of parents which probably averaged much lower when entering. Pieces of uninfected beetle-wood found in the field produced as high as 25 per cent of positive beetles.

Uninfected elm wood in farmers' woodpiles also produced positive beetles. Diseased wood cut in short lengths and piled produced as high as 16 per cent of positive beetles when stored out-of-doors and as high as 9 per cent when stored in sheds. Healthy wood cut and stored in a similar way, but subjected to entry by spore-bearing beetles, produced 14 per cent of positive beetles when stored out-of-doors and 19 per cent when stored in a shed.

In 1939, in the counties of Ulster, Columbia, and Dutchess, that is, in the peripheral regions of the disease area, 217 of the 304 confirmed trees were inspected. Of these, 127 were recorded as having become infected in 1939. In the vicinity of 65 of these trees, uninfected wood which had produced *Scolytus multistriatus* in the spring or early summer of 1939 was discovered. In these instances there appeared to be a definite correlation of beetle emergence and beetle feeding with the probable time of infection.

This led to the inference that the disease pathogen was communicated to these trees by beetles which had emerged from uninfected wood. Whether this inference is justified in every instance, it was shown that uninfected wood can, and often does, produce beetles which carry inoculum. Dead or dying elm wood of whatever origin, if suitable for the breeding of *Scolytus multistriatus*, is therefore a potential source of inoculum from which the Dutch elm disease pathogen may be spread by emerging beetles. Since the beetles can carry the fungus into uninfected wood, and their progeny can carry it out, such wood serves as a reservoir for continuing local dissemination of the disease organism. It may also act as a bridge for the transfer of the fungus from the disease area to regions where the disease does not occur.

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The Business of Milk Retailing by Producer-Distributors in New York State

Earl M. Hughes

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THE BUSINESS OF MILK RETAILING BY PRODUCER-DISTRIBUTORS IN NEW YORK STATE[1]

EARL M. HUGHES

STATEMENT OF THE PROBLEM AND METHODS OF STUDY

PURPOSE OF THE STUDY

Approximately 8 per cent of the milk produced in New York State is distributed by producer-distributors; that is, by distributors who are producing all or part of their own milk supply (table 1). Producer-distribution of milk is less important in New York than in some other States. In general, the areas in the United States that have many small towns and a rather large population in relation to the local milk supply have a greater percentage of the milk distributed by producer-distributors. The leading States in the proportion of the total milk supply distributed by producers are: Florida, New Jersey, Massachusetts, Arizona, Connecticut, Maine, Pennsylvania, New Mexico, and Delaware (figure 1).

TABLE 1. MILK DISPOSED OF IN VARIOUS WAYS BY FARMERS IN NEW YORK STATE, 1936*

Item	Disposal	
	Millions of pounds	*Per cent*
Milk used on farms:		
As milk or cream	390	5.4
For making butter	210	2.9
For feeding calves	254	3.6
Total used on farms	854	11.9
Milk separated for sale:		
As butterfat	150	2.1
Sales of milk and market cream:		
Retail	570	7.9
Wholesale	5,614	78.1
Total milk disposed	7,188	100.0

*Milk production and utilization in the United States, 1934, 1935, 1936. Mimeographed report, Bur. Agr. Econ., U. S. Agr. Dept. February 1938.

Although only 8 per cent of the milk produced in New York is retailed by producers, more than 50 per cent of the total number of distributors in the State are producer-distributors (table 2).

It has been the purpose of this study to ascertain the amount and variation of costs and profits in the distribution of milk by a representative group of producer-distributors in New York State; to measure the effect of various factors upon these costs and profits, so as to determine the

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[1] Also presented to the Faculty of the Graduate School of Cornell University, September, 1938, as a thesis in partial fulfillment of the requirements for the degree of doctor of philosophy.

AUTHOR'S ACKNOWLEDGMENTS. The writer wishes to express his appreciation to the producer-distributors for their cooperation in providing information on their business operations, and thereby making this study possible. The Division of Milk Control and the Bureau of Statistics, of the New York State Department of Agriculture and Markets, also furnished many valuable data. Grateful acknowledgment is made to Dr. Leland Spencer, of the Department of Agricultural Economics and Farm Management, New York State College of Agriculture, for advice and suggestions in analyzing the data and in the preparation of the manuscript; and to Dr. George F. Dow and Professors G. P. Scoville, F. A. Harper, and F. A. Pearson for their many valuable suggestions.

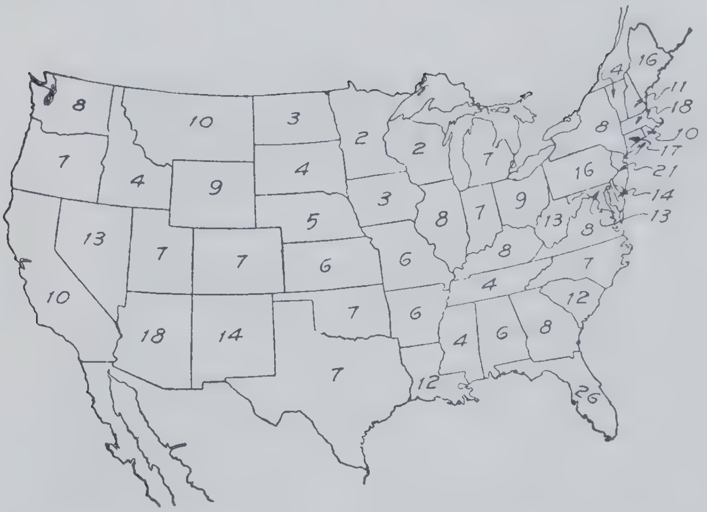

FIGURE 1. PERCENTAGE OF TOTAL MILK PRODUCTION RETAILED BY PRODUCERS

(Average for United States = 6.8 per cent)

Data taken from *Milk Production and Utilization in the United States, 1934, 1935, 1936* (mimeographed report of the United States Department of Agriculture, Bureau of Agricultural Economics, February 1938)

principles of successful organization and management for small milk-distribution enterprises; and in general, to ascertain the conditions under which farmers are most likely to succeed in the distribution of their own milk.

Detailed records of the milk-retailing operations for 92 producer-distributors were taken by the survey method.[2] Data relative to the yearly receipts and expenses, as well as inventories, capital invested, quarts of milk and cream sold in different containers, prices received, number of routes, number of customers, and other pertinent information, were obtained from each distributor. In most cases, information concerning the farm business, as well as the milk-distribution enterprise, was obtained.

TABLE 2. NUMBER OF LICENSED MILK DISTRIBUTORS IN NEW YORK STATE, CLASSIFIED BY SOURCE OF MILK SUPPLY, SEPTEMBER 1937*

Source of supply	Distributors	
	Number	*Per cent*
Distributors producing all or part of their milk supply:		
Own herd	1,256	36.0
Own herd and purchase from farmers	323	9.3
Own herd and purchase from dealers	203	5.8
Total producer-distributors	1,782	51.0
Distributors buying all their milk supply:		
Distributors purchasing from farmers	959	27.5
Distributors purchasing from other dealers	751	21.5
Total buying distributors	1,710	49.0
Total, all distributors	3,492	100.0

*Data supplied by the Division of Milk Control, Albany, New York.

Nearly all the producer-distributors interviewed had records of total income and total expenses, but only a few kept satisfactory records of the quantities of milk and cream sold monthly in the various-sized containers, or of the individual items of expense. Many of the data on milk and cream supply and utilization were obtained from copies of reports filed with the State Division of Milk Control. For other essential data, it was necessary to rely upon the operator's estimates. The information obtained from all sources was cross-checked for accuracy whenever possible. For example, the estimated total number of units of milk and cream sold daily was multiplied by the price per unit, and this figure checked with the receipts from the route. The total milk equivalent of sales also was checked against the supply.

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[2] Copies of the survey schedules are available on request at the Department of Agricultural Economics and Farm Management, New York State College of Agriculture, Ithaca, New York.

The record of each business covered the latest complete fiscal year. There was some variation in dates, but in all cases, the end of the fiscal year fell between December 31, 1935, and July 1, 1936.

Producer-distributors are located fairly generally over the State, but the largest number are in the southeastern district (table 3 and figure 2). In the numerous small towns of Long Island and Westchester County, producer-distributors apparently can compete more successfully than they can in the larger markets.

TABLE 3. DISTRIBUTION OF PRODUCER-DISTRIBUTORS BY DISTRICTS AND BY SOURCE OF MILK SUPPLY, NEW YORK STATE, SEPTEMBER 1937*

District†	Number of distributors with each source of milk supply			
	Own herd only	Own herd and purchase from farmers	Own herd and purchase from other dealers	All producer-distributors
Northeast	80	28	6	114
East	173	54	47	274
Southeast	343	61	87	491
South	74	11	5	90
Southwest	137	39	11	187
West	139	50	15	204
Central	221	57	23	301
North	89	23	9	121
Total	1,256	323	203	1,782

*Data supplied by the Division of Milk Control, Albany, New York.
†For location of districts, see figure 2.

The records of producer-distributors who were included in this study have been segregated in four groups according to location in different areas of the State; namely, the Jamestown area, the central New York area, the Capital District (parts of Albany, Saratoga, Schenectady, and Rensselaer Counties), and the Long Island area. The principal difference between these areas is in the general level of prices for milk. The Jamestown area is a remote section of the New York milkshed, and therefore has a low level of milk prices. Long Island, lying on the opposite side of the great New York market from the principal milk-shipping counties, has the highest milk prices in the State. Prices in the other areas are intermediate between these two. The number of businesses studied in each of the areas is shown in table 4.

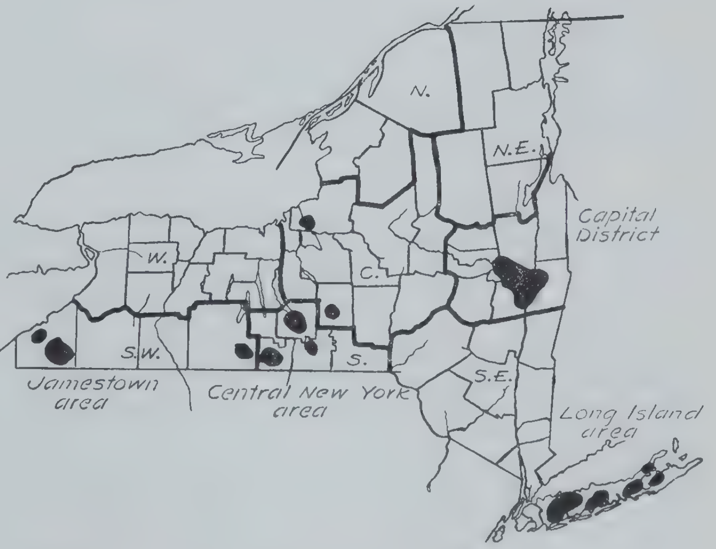

FIGURE 2. DISTRICTS OF NEW YORK STATE
The darkened areas indicate where records were taken

TABLE 4. NUMBER AND SIZE OF MARKETS SERVED BY PRODUCER-DISTRIBUTORS IN EACH OF THE FOUR AREAS STUDIED, 1935–36

Area	Number of distributors	Number of cities and villages served in each area	Total population of all cities and villages served in each area
Jamestown	27	6	55,510
Central New York	28	21	130,802
Capital District	15	17	366,887
Long Island	22	16	62,729
All areas	92	60	615,928

ECONOMIC CONDITIONS DURING THE PERIOD COVERED BY THE SURVEY

Beginning in 1929 and continuing until 1933, the farm price of milk, as well as the prices of other basic commodities, declined very rapidly (figure 3). As usual during periods of price deflation, the retail price of milk was reduced much less than was the price received by farmers. This resulted in a wide spread between the prices received by farmers and the prices paid by consumers (figure 4). From 1933 to 1937, milk prices, as well as other prices, were rising rapidly, but the spread between farm and retail prices continued wider than usual. With the farm price of milk relatively low compared with the retail price, the attention of farmers was focused upon the possibility of increasing the returns for their milk by selling to the consumer instead of to a dealer.

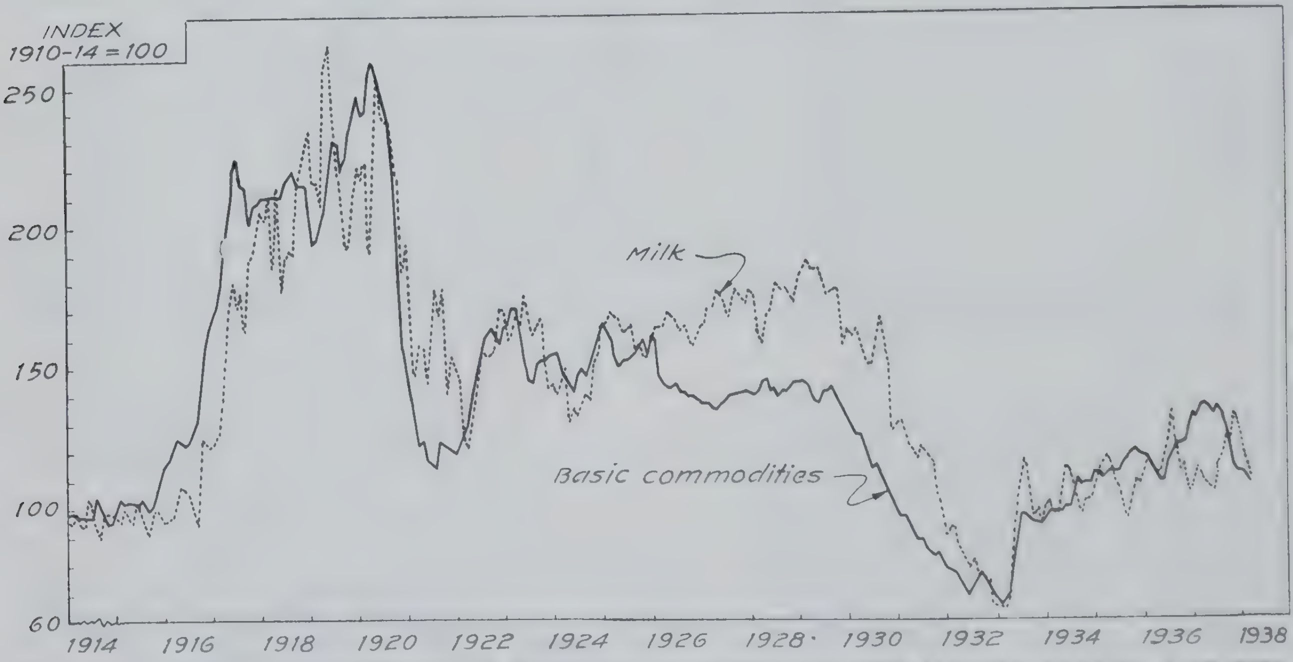

FIGURE 3. WHOLESALE PRICES OF BASIC COMMODITIES IN THE UNITED STATES, AND THE FARM PRICE OF MILK IN NEW YORK, 1914–36

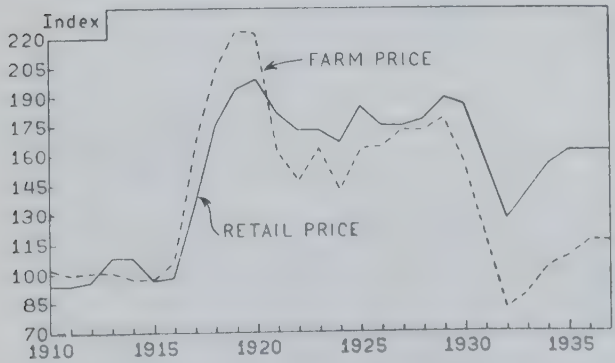

FIGURE 4. RETAIL PRICES OF MILK IN BUFFALO, AND NET FARM PRICES OF MILK IN NEW YORK, 1910–37
(1910–1914 = 100)

The reason most frequently given by farmers included in this survey, for starting to retail, was the low price they had been getting for milk. About 40 per cent of the operators included in this study had been in the retail business for ten years or less (table 5). Many had started during the depression. At that time, the retail price appeared especially attractive to farmers who had the opportunity for direct selling. Unlike the larger milk dealers, they could sell nearly all their milk in fluid form at the retail price. Many producers found that they could get larger net returns by selling milk direct to consumers at cut prices than by selling to a country milk plant. In 1933, the State of New York undertook the job of fixing the prices to be paid by milk dealers to producers, also the resale prices to consumers and other customers.

TABLE 5. LENGTH OF TIME THAT PRODUCER-DISTRIBUTORS HAVE BEEN ENGAGED IN THE RETAILING OF MILK, 81 PRODUCER-DISTRIBUTORS, 1935–36

Year group	Distributors	
	Number	*Per cent*
0–5 years	19	23
6–10 years	15	19
11–15 years	22	27
16–20 years	8	10
21 or more years	17	21
Total	81	100

The fact that this study was made during a period of price-fixing by State authorities must be considered in interpreting the results. For one thing, the margins and profits of the milk-distribution enterprise are affected by valuing the milk produced by these distributors, as well as the milk and cream purchased from farmers or from other dealers, at the official price of the Milk Control Board. This price (about 5 cents per quart) was higher than many of the farmers could have obtained in the best alternative market. In general, however, price-fixing caused the profits from producer-distribution of milk to be higher than they would have been otherwise. The increased returns from the arbitrarily enhanced retail prices more than offset the extra cost of milk purchased by these distributors.

BUSINESS ANALYSIS OF THE MILK-DISTRIBUTION ENTERPRISE

SUMMARY OF SALES, COSTS, AND PROFITS

In general, the volume of business of the producer-distributors of milk is small in comparison with that of other milk dealers. The gross sales for the year, of the 92 producer-distributors included in this study, amounted to about 127,000 quarts of milk, or about $13,700 per distributor (table 6). The average price for all milk sold during the year was 10.78 cents a quart.

When the value of milk produced on the distributor's farm is figured at the average Milk Control Board price[3] for the area, and to this is added the cost of the milk and other products purchased, the total product cost per dealer is $7219, or 5.68 cents a quart. Product costs averaged 52.7 per cent of the sales. The difference between the returns for all products sold and the product cost at the plant is designated as the gross

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[3] The Milk Control Board price for milk purchased by producer-distributors was 75 per cent of the Class I price plus 25 per cent of the Class 2A price.

TABLE 6. SUMMARY OF SALES, COSTS, AND PROFITS FOR 92 PRODUCER-DISTRIBUTORS OF MILK, 1935–36

Item	Amount per distributor	Amount per quart	Proportion of selling price
	Dollars	*Cents*	*Per cent*
Sales	13,699	10.78	100.0
Product cost*	7,219	5.68	52.7
Gross spread	6,480	5.10	47.3
Operating cost†	5,128	4.03	37.4
Net operating profit	1,352	1.07	9.9
Other income	80	0.06	0.6
Total net profit	1,432	1.13	10.5

*Includes calculated value of milk and other products from the operator's farm.
†Includes interest at five per cent on all capital, and charges for unpaid labor.

spread. This amounted to $6480 per distributor, or approximately 5 cents per quart, and constituted about 47 cents in each dollar of sales.

The total operating cost was $5128 per distributor, or about 4 cents per quart, and constituted about 37 per cent of the total sales. This is a somewhat lower percentage of gross sales than studies of larger milk dealers' operations have disclosed.[4] When the operating cost of $5128 is deducted from the gross spread, the result is a net operating profit of $1352 per distributor. In addition to this, there was some additional income from dividends, interest on accounts, returns from custom-pasteurizing and bottling, and other items amounting to an average of $80 per distributor. Thus the total net profit was $1432 per distributor, or slightly more than one cent per quart, and constituted about 10 per cent of the total sales. The profits would be somewhat larger if figured by the usual accounting procedure in which interest on owner's capital and the value of unpaid labor are not treated as costs.

RANGE IN SALES, COSTS, AND PROFITS

There were wide variations in the sales, costs, and profits of the several distributors whose records were analyzed in this study. The greatest differences were due to the type of business, whether raw milk or pasteurized, and to the location, whether on Long Island or upstate. But even among distributors similarly situated as to type of business and location, there were substantial differences that are related to the organization and management of the business.

The yearly sales of the several distributors varied from $1138 to $87,611 (table 7). The sales of the pasteurizing distributors averaged more than twice as much as the sales of the distributors selling raw milk. The range in gross sales for the distributors of pasteurized milk was $1944 to $87,611, whereas the range for the distributors of raw milk was from $1138 to $37,464. There were only two raw-milk distributors with sales amounting to more than $15,000.

Variations of similar magnitude were found among the several distributors in respect to product costs and operating expenses. The yearly

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[4] The operating cost for 21 upstate milk dealers, August 1933, amounted to 42.6 per cent of gross sales, and for 19 New York City dealers during the same month, 48.6 per cent of sales.
Source: *Cost and Profits of Milk Dealers'in Upstate Cities, August 1933*, by Leland Spencer (Dept. Agr. Econ., Cornell Univ., in cooperation with New York State Milk Control Board. Mim. rept., A. E. 79, 1934), also *Costs and Profits of Milk Dealers in New York City, August 1933*, by Leland Spencer (Dept. Agr. Econ., Cornell Univ., in cooperation with Division of Milk Control, New York State Dept. Agr. and Markets. Mim. rept., A. E. 80, 1934).

TABLE 7. RANGE AND AVERAGE OF YEARLY SALES, COSTS, AND PROFITS OF 41 PRODUCER-DISTRIBUTORS SELLING RAW MILK AND 51 PRODUCER-DISTRIBUTORS SELLING PASTEURIZED MILK, 1935–36

Item	41 distributors of raw milk			51 distributors of pasteurized milk		
	High	Low	Average	High	Low	Average
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Sales	37,464	1,138	8,128	87,611	1,944	18,178
Product cost	15,997	613	4,159	45,328	933	9,680
Gross spread	21,467	374	3,969	42,283	1,011	8,498
Operating costs	10,021	450	2,830	38,785	1,651	6,975
Net operating profit	11,446	–1,295	1,139	10,960	–2,717	1,523
Other income*	†	†	†	2,676	†	143
Total net profit	11,446	–1,295	1,139	10,960	–2,717	1,666

*Other income consists of income from custom bottling, pasteurizing, bottle washing, rent of truck, interest and dividends received, and the like.

†These distributors had no miscellaneous income from the above sources.

profit or loss for the 51 distributors of pasteurized milk ranged from a loss of $2717 to a profit of $10,960, with an average profit of $1666. There was also a wide range in the profit and loss for the distributors of raw milk. Although the average profit for all distributors of raw milk was somewhat less than for the distributors of pasteurized milk, it made up a larger percentage of sales.

The wide differences in profits of these producer-distributors are due in part to the variation between markets in respect to the prevailing buying and selling prices for milk, wage rates, and other conditions over which the individual distributors have no control. For example, the profits were considerably larger for the distributors in the Capital District than for those in other areas (table 8).

TABLE 8. AVERAGE SALES, COSTS, AND PROFITS FOR 92 PRODUCER-DISTRIBUTORS OF MILK IN FOUR MARKET AREAS, 1935–36

Item	Jamestown	Central New York	Capital District	Long Island	All distributors
Number of dealers	27	28	15	22	92
Average volume, quarts per day	368	366	461	221	347
	Average amounts per distributor				
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Sales	12,929	14,297	17,505	11,289	13,699
Product cost	6,984	7,311	9,069	6,130	7,220
Gross spread	5,945	6,986	8,436	5,159	6,480
Operating cost	4,775	5,597	5,450	4,744	5,128
Net operating profit	1,170	1,389	2,986	415	1,352
Other income	127	138	.....	.....	79
Total net profit	1,297	1,527	2,986	415	1,431
	Amounts per quart of milk equivalent sold				
	Cents	*Cents*	*Cents*	*Cents*	*Cents*
Sales	9.60	10.68	10.38	13.98	10.78
Product cost	5.19	5.46	5.38	7.59	5.68
Gross spread	4.41	5.22	5.00	6.39	5.10
Operating costs	3.54	4.18	3.23	5.88	4.03
Net operating profit	0.87	1.04	1.77	0.51	1.07
Other income	0.09	0.10	.....	.....	0.06
Total net profit	0.06	1.14	1.77	0.51	1.13

The main reason for the high earnings of the Capital District distributors was low operating costs, which in turn resulted from larger than average volume of business. The Long Island distributors, on the other hand, made small profits. Their selling prices were high, but this advantage was more than offset by high costs.

There was a wide range in the selling prices per quart of milk equivalent. The selling price for the 41 distributors handling raw milk varied from 9.20 cents to 15.75 cents a quart. The average was 12.54 cents a quart. The selling price for the 51 pasteurizing distributors varied from 8.09 cents to 14.20 cents per quart, and averaged 10.26 cents per quart. This wide range is due partly to differences in location and partly to differences in quality. The selling price for the Long Island group averaged about 4 cents a quart higher than that for the upstate distributors. In both the raw-milk and the pasteurized-milk groups, the distributor with the highest selling price was located on Long Island. There was little variation in the selling price in the upstate markets. Variation in the quality of products sold is another factor causing a variation in the selling price. In some cases, a special grade of Guernsey, or other high-testing milk, was sold. Vitamin D and special Grade A raw milk also sold for a substantial premium over the regular raw or pasteurized milk. In some markets raw milk sold for one cent a quart more than pasteurized milk.

The product cost for the 51 distributors of pasteurized milk varied from 4.69 cents to 7.59 cents, and averaged 5.47 cents a quart.

Aside from the differences in profits due to type of business and market conditions, some producer-distributors have been much more successful than others because of superior business organization and management. To isolate and measure the effect of factors that contribute to such success is the main objective of the analysis that follows.

SALES ANALYSIS

Products sold

Retail milk in quart bottles was the only product handled by all of the producer-distributors included in this study (table 9). Eighty-one of these distributors also handled retail milk in pint bottles. These two products, together with wholesale milk in quart bottles and 40-per-cent cream in one-half pint bottles, were the items most frequently handled by the distributors interviewed. Only a limited number of distributors handled the other products, such as bulk milk and the various grades of cream. Five grades of milk and cream were sold, based on sanitary requirements, namely: Grade A pasteurized, Grade B pasteurized, Grade A raw, Grade B raw, and Special A raw. There were also two general grades of milk, based on butterfat content. Usually these two grades were referred to as regular, or Holstein, milk, and Special, or Guernsey, milk. In some instances, other grades of special-quality milk, such as Vitamin D milk, were offered for sale. Three grades of cream were handled, based on butterfat content: heavy, or 40-per-cent; medium, or 30-per-cent; and light, or 20-per-cent butterfat content. Most distributors handled only one grade of milk and usually only one or two grades of cream. In all, some 50 different products were handled by the various

TABLE 9. PRODUCTS SOLD BY 92 PRODUCER-DISTRIBUTORS, 1935–36*

Product	Bottled goods			Bulk goods
	Quarts	Pints	½ pints	
	Number of distributors selling each product			
Regular milk:				
Retail	92	81	3	..
Wholesale	70	38	22	19
Other dealers†	40	2	1	9
Special milk:				
Retail	19	11	1	..
Wholesale	6	2	1	2
Other dealers†	3	1	..	..
Cream, 20-per-cent:				
Retail	5	6	26	..
Wholesale	6	4	8	1
Other dealers†	4	1	2	..
Cream, 30-per-cent:				
Retail	8	7	23	..
Wholesale	2	1	16	..
Other dealers†	1	..	1	..
Cream, 40-per-cent:				
Retail	8	7	67	..
Wholesale	14	3	30	9
Other dealers†	4	2	7	10

*In addition to the products listed above, 21 distributors were selling chocolate milk; 14, buttermilk; 16, eggs; 11, skimmilk; 11, butter; 5, orange drink; 3, cottage cheese; 2, vegetables; 1, chocolate syrup; 1, maple syrup; 1, poultry; 1, potatoes.

†Includes any sales of milk or cream made at the plant.

distributors. Only a few of the larger distributors attempted to push the sales of by-products. The most important by-product, both as to volume and as to number of distributors, was chocolate milk. Raw-milk distributors handled fewer by-products than did the pasteurizing distributors.

Method of measuring volume of business

Because of the many different products sold, both at retail and at wholesale, in various-sized containers and packages, it was necessary to reduce these units to a common denominator as a measure of the physical volume of business. Three possible bases of measurement are: container units, quarts of milk equivalent, and quarts of retail milk equivalent (table 10). Substantially the same results are obtained whether the volume of sales is measured by container units or by quarts of milk equivalent. Since most farmers are accustomed to thinking in terms of whole milk rather than in terms of a calculated retail milk equivalent, or container units, it was thought to be more practical to use as a common denominator, in this study, the quart of milk equivalent. Unless otherwise stated, all unit costs have been calculated on this basis. The reader should be cautioned against thinking that this is synonomous with a retail quart of milk delivered to the consumer's doorstep. The quart of milk equivalent differs from the quart of retail milk equivalent in that each quart is given the same weight, regardless of the method of distribution. Many other studies of the cost of distributing milk have also been based on the milk equivalent of the products sold or of the total volume of milk received at the plant.

TABLE 10. DAILY SALES PER DISTRIBUTOR AS MEASURED BY DOLLAR RECEIPTS, CONTAINER UNITS, QUARTS OF MILK EQUIVALENT, AND QUARTS OF RETAIL MILK EQUIVALENT SOLD, 92 PRODUCER-DISTRIBUTORS, 1935–36

Product sold	Total receipts, daily	Container units sold, daily	Milk equivalent sold, daily	Retail milk equivalent, daily
	Dollars	*Number*	*Quarts*	*Quarts*
Retail milk:				
Quarts	22.63	182.1	182.1	182.1
Pints	1.89	26.0	13.0	18.2
One-half pints	0.03	0.8	0.2	0.4
Wholesale milk:*				
Quarts	5.48	63.5	63.5	38.5
Pints	0.57	9.4	4.7	4.6
One-half pints	0.48	14.7	3.7	5.3
Bulk	0.70	9.0†	9.0	4.1
Retail cream:				
Quarts	0.08	0.1	1.0	0.2
Pints	0.04	0.1	0.4	0.1
One-half pints	2.42	12.1	25.8	7.6
Wholesale cream:*				
Quarts	0.76	1.5	12.9	1.1
Pints	0.02	0.2	0.9	‡
One-half pints	0.97	5.9	13.1	2.7
Bulk	0.38	0.8†	7.4	0.5
By-products	0.99	§	9.5	9.3
Total	37.44	326.2	347.2	274.7

*Includes sales made at the distributor's plant.
†Figures given in quarts of product.
‡Less than 0.05 quart.
§Data not available.

Variation in type of sales

On the basis of milk equivalent as calculated by the above method, about 80 per cent of the sales for all producer-distributors included in this study were in the form of fluid milk (table 11). This includes both

TABLE 11. TOTAL SALES OF MILK EQUIVALENT CLASSIFIED BY KIND OF PRODUCT AND TYPE OF SALE, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	Jamestown	Central New York	Capital District	Long Island	All areas
	Per cent of milk equivalent				
Milk:					
Retail on route	45.6	59.5	49.7	80.6	56.3
Wholesale on route	21.1	16.8	11.8	7.2	15.6
Other milk sales*	5.2	4.4	21.0	1.0	7.7
Total milk	71.9	80.7	82.5	88.8	79.6
Cream:					
Retail on route	8.5	7.0	6.6	10.0	7.8
Wholesale on route	11.5	7.7	3.8	0.5	7.0
Other cream*	3.9	2.1	4.8	....	2.9
Total cream	23.9	16.8	15.2	10.5	17.7
By-products	4.2	2.5	2.3	0.7	2.7
Total	100.0	100.0	100.0	100.0	100.0

*Includes sales of milk and cream made at the plant to other dealers, and also a small quantity of retail sales not made on the route.

retail sales and wholesale sales, and sales made at the plant to other dealers. About 18 per cent of the total milk equivalent was disposed of as cream, and about 3 per cent in the form of by-products.

There was considerable variation between the areas in the proportion of the total milk equivalent disposed of as fluid milk. The Long Island producer-distributors sold nearly 90 per cent as fluid milk, whereas those in the Jamestown area sold only about 70 per cent as fluid milk. The distributors in the central New York area and in the Capital District disposed of about 80 per cent of their supply as fluid milk.

The amount of milk and cream sold at the retail price also was highest in the Long Island area and lowest in the Jamestown area and in the Capital District. Apparently in the areas where the average volume of milk sold by the distributors is relatively small, a high percentage of the milk is disposed of as fluid milk and also a high percentage of both milk and cream are sold at the retail price.

By-products were relatively unimportant in the total volume. In no area did items other than milk or cream make up over 4½ per cent of the total quarts of milk equivalent. This item was highest in the Jamestown area and lowest in the Long Island area. The smaller producer-distributors feel that they can afford to carry only a limited amount of by-products.

When the producer-distributors are grouped into those selling pasteurized milk and those selling raw milk, it is found that the raw-milk distributors sold 86 per cent of their milk equivalent as fluid milk, whereas the pasteurizing distributors sold only about 78 per cent of their milk in this form. The raw-milk distributors also sold about 87 per cent of their milk equivalent at the retail price, whereas the distributors of pasteurized milk sold only 58 per cent of their milk at the retail price. This difference seems to be closely related to the volume of milk handled by the two types of distributors. The average volume for the raw-milk distributors was 177 quarts of milk equivalent per day, and the average volume for the pasteurizing distributors was 484 quarts of milk equivalent per day.

Seasonal variation in volume and utilization of milk

The largest amount of total milk equivalent was handled in the month of May (figure 5). When the daily sales of milk each month were expressed in terms of the average daily sales for the year, the sales in May were 106 and the sales in October were 94, a comparatively small range. The total sales would show somewhat more of a dip in the summer if the Long Island records were not included, because the sales there are much larger in the summer months than for the remainder of the year.

The total sales of milk, as such, for all areas were highest in May (table 12). Cream sales were

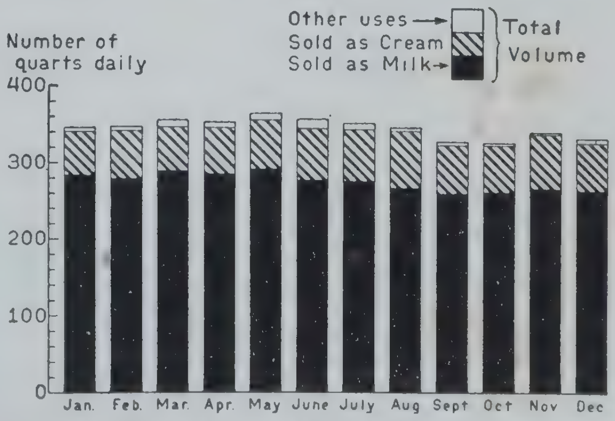

FIGURE 5. SEASONAL VARIATION IN VOLUME AND UTILIZATION OF MILK HANDLED BY 92 PRODUCER-DISTRIBUTORS IN NEW YORK STATE, 1935–36

TABLE 12. SEASONAL VARIATION OF MILK SALES BY AREAS, 92 PRODUCER-DISTRIBUTORS, 1935–36
(Daily averages for the year = 100)

Month	Jamestown	Central New York	Capital District	Long Island	All areas
January	107	101	110	91	103
February	110	103	97	92	102
March	117	102	105	92	105
April	109	101	107	97	104
May	106	103	113	103	106
June	91	99	106	112	101
July	96	97	102	113	100
August	91	95	97	112	97
September	89	97	90	104	94
October	93	102	88	97	95
November	96	101	93	95	97
December	95	100	93	92	96
Average	100	100	100	100	100

largest during the summer months. All other milk includes milk used for butter and for ice cream, and sales to butter factories. These sales were largest during the flush season of the year, but at all times they constituted a very small proportion of the total sales of milk equivalent.

Selling prices

During the period covered by this survey, the New York State Division of Milk Control fixed the prices to be charged by dealers for milk and cream sold to consumers and other customers. Most of the retail milk in quart bottles was sold by distributors to consumers at 15 to 16 cents on Long Island, and at 12 cents in the upstate areas.[5] Jamestown was the only city included in the survey which had a retail price of 11 cents. In a number of small villages, the retail price was 10 cents per quart. Prices of Vitamin D milk were 1 cent per quart and 1 cent per pint higher than the prices for regular milk in each area. The price of all milk containing 4.2 per cent or more butterfat was set 1 cent per quart higher than the established minimum prices for regular milk in the area, with a corresponding premium upon pints and half-pints.

The average selling price per quart of milk equivalent amounted to about 10¾ cents for all the areas studied (table 13). The distributors on Long Island received the highest average price, nearly 14 cents per quart;

TABLE 13. AVERAGE SELLING PRICES PER QUART OF MILK EQUIVALENT FOR 92 PRODUCER-DISTRIBUTORS IN FOUR MARKET AREAS, 1935–36

Area	Selling price per quart of milk equivalent		
	High distributor	Low distributor	Average for all distributors
	Cents	*Cents*	*Cents*
Jamestown	11.49	8.60	9.60
Central New York	13.35	8.84	10.68
Capital District	13.18	8.09	10.38
Long Island	15.75	12.20	13.98
All dealers	15.75	8.09	10.78

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[5] The schedule of minimum prices for milk and cream is given in the Appendix, table 74, page 76.

and the distributors in the Jamestown area received the lowest average price, about 9½ cents per quart. Those in the central New York area and in the Capital District received an average price of about 10½ cents per quart. The average selling price is affected by the proportion of milk sold as milk, as cream, and as by-products; by the amount of milk going into retail and wholesale classifications; and by the retail and wholesale prices in effect in each of the areas studied.

Sanitary regulations

Before any person can sell or offer for sale milk or cream to consumers in the State of New York, it is necessary that he obtain a permit from the local health officer. Before permits can be issued, the premises and equipment must be inspected and approved by a representative of the State Department of Health.

Definite requirements for the various grades of milk are set up in the State Sanitary Code. The grades are: Certified pasteurized; Grade A pasteurized; Grade B pasteurized; Certified raw; Special A raw; or Grade A raw.

No dairies producing certified milk were included in this study. Most of the producer-distributors were selling Grade A or B pasteurized, or Grade A raw milk, and a few were selling Special A raw.

At the time of this survey, only pasteurized, certified raw, certified pasteurized, or Special A raw milk was permitted to be sold in cities and villages of over 15,000 population. Sales of Grade A and Grade B raw milk were confined to cities and villages of 15,000 population or less. This requirement was later amended so that the latter two grades of milk could not be sold in cities and villages of over 10,000 population.

The numerous sanitary requirements for each grade of milk pertain to bacteria counts, veterinary inspection of cows, medical examination of milk handlers, period of time milk may be held before delivery, temperature at time of delivery, type of bottle cap, construction of milk plant, and the like. The principal differences in the requirements for raw milk as compared to pasteurized are in the lower bacteria counts, and in the more strict health requirements for both cows and men. The bacteria counts for raw milk are lower than for Grade B pasteurized milk. Also cows must be tested for tuberculosis and Bang's disease, whereas this is not required for the production of pasteurized milk. A tabulation of the various sanitary requirements for the several grades of milk appears in the Appendix, table 75, page 77.

MILK SUPPLY

Source of supply

The average quantity of milk handled during the year by one of the producer-distributors included in this survey was about 130,700 quarts (table 14). This amounts to an average of 357 quarts, or about 9 forty-quart cans, per day. Of this amount, two-thirds was produced on the distributor's farm and one-third was purchased from other farmers or dealers. About 75 per cent of the total purchases consisted of milk bought from farmers, f. o. b. the producer-distributor's plant. In addition, a small amount of milk and cream was purchased from other deal-

TABLE 14. PRODUCTION AND PURCHASES OF MILK AND THE MILK EQUIVALENT OF CREAM AND OTHER PRODUCTS, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	Jamestown	Central New York	Capital District	Long Island	All areas
Total quantity per distributor (quarts)	140,504	136,892	173,117	81,885	130,705
Per cent of total supply produced:					
Milk	49.6	79.9	52.4	83.6	64.9
Other*	0.3	0.5	0.1	.....	0.3
Total	49.9	80.4	52.5	83.6	65.2
Per cent of total supply purchased:					
Milk from farmers	38.8	16.3	36.5	4.2	26.0
Milk from dealers	1.8	1.0	7.7	4.2	3.2
Cream from dealers	9.1	2.0	2.5	7.7	5.2
Other*	0.4	0.3	0.8	0.3	0.4
Total	50.1	19.6	47.5	16.4	34.8

*Allowance for eggs, meat, vegetables, and the like.

ers. The purchases of by-products to be distributed on the route were of minor importance.

There was much variation in the amount of milk produced by the distributors in the different areas surveyed. In the Jamestown area and in the Capital District, production on the distributors' farms constituted only about 50 per cent of the milk equivalent sold, while the comparable figure for Long Island was 84 per cent.

The largest purchases of milk and cream were made in the areas where the largest businesses were. Apparently it is easier to increase the size of the retailing enterprise by purchasing additional milk than by producing more.

When the producer-distributors selling raw milk were studied separately from those selling pasteurized milk, it was found that the raw-milk distributors produced 87 per cent of their milk supply, while the pasteurizing distributors produced only 59 per cent (table 15). This is a more pronounced difference than was found between the areas, and it

FIGURE 6. BARNS OF A PRODUCER-DISTRIBUTOR IN THE CAPITAL DISTRICT

About 50 cows were kept on this farm. Two delivery routes were operated

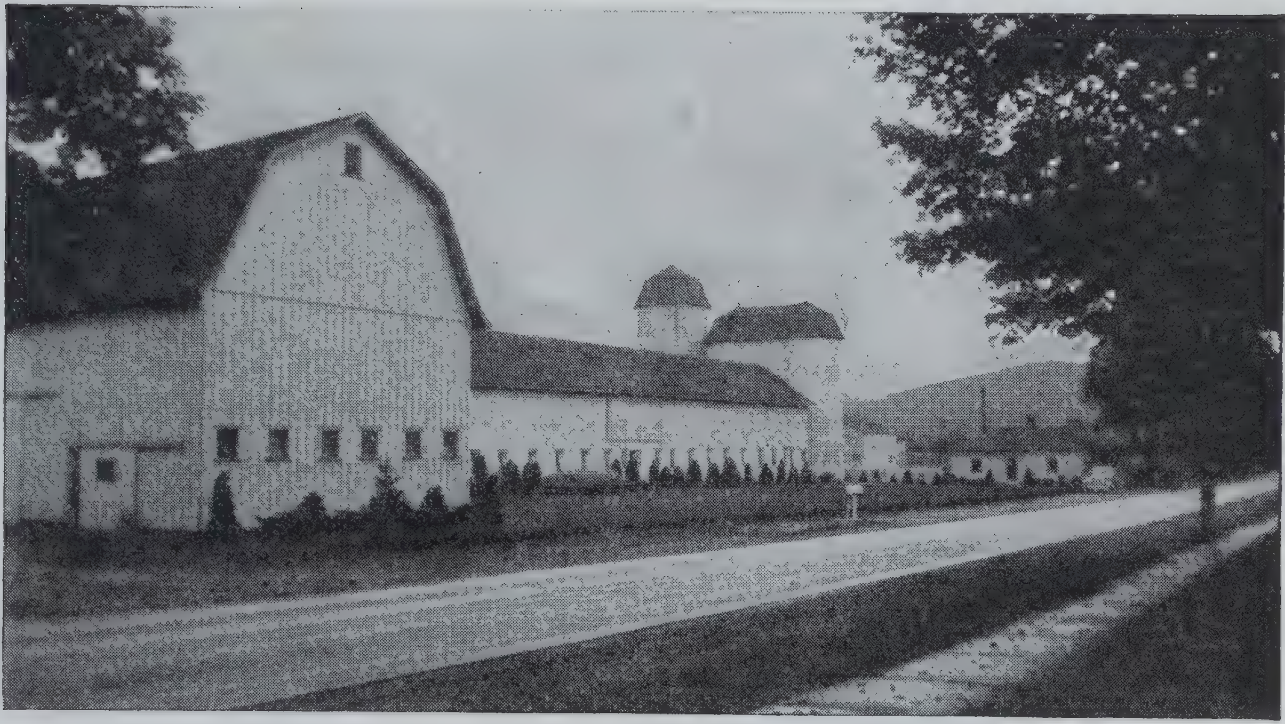

FIGURE 7. BARNS OF A PRODUCER-DISTRIBUTOR IN THE CENTRAL NEW YORK AREA

The milk plant is shown at the extreme right. 125 cows were kept on this farm and three delivery routes were operated

TABLE 15. PRODUCTION AND PURCHASES OF MILK AND THE MILK EQUIVALENT OF CREAM AND OTHER PRODUCTS, FOR DISTRIBUTORS OF RAW MILK AND DISTRIBUTORS OF PASTEURIZED MILK, 1935–36

Item	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
Total quantity per distributor (quarts)	66,284	182,493	130,705
Per cent of total supply produced:			
Milk	86.7	58.6	64.9
Other*	0.3	0.3	0.3
Total	87.0	58.9	65.2
Per cent of total supply purchased:			
Milk from farmers	6.7	31.6	26.0
Milk from dealers	3.0	3.2	3.2
Cream from dealers	3.1	5.8	5.2
Other*	0.2	0.5	0.4
Total	13.0	41.1	34.8

*Allowance for eggs, meat, vegetables, and the like.

can be explained largely by the increased cost of handling pasteurized milk. It is necessary for the pasteurizing distributors to have a larger volume of business in order to offset the additional costs of operation. Apparently the pasteurizing distributors have increased their production, as well as their purchases, but the latter method has been used more frequently. It probably is a more sound farm-management practice to purchase the additional milk than it is to expand the herd if the present cow-carrying capacity of the barns and farm has been reached.

Butterfat test of milk supply

The average butterfat test of all milk handled by the 92 producer-distributors included in the survey, as reported to the Division of Milk Control at Albany, was 3.91 per cent (table 16). There was little difference in test as between the milk produced and that purchased, nor was there much variation between the several areas. The lowest yearly average test of milk delivered by any distributor was 3.4 per cent, and the highest average test was 5.0 per cent. In general, the producer-distributors interviewed were delivering a good quality of product as judged by butterfat test. The average test of all producer-distributors reporting to the Division of Milk Control in 1936 was 3.95 per cent.

TABLE 16. BUTTERFAT TEST OF MILK PRODUCED AND MILK PURCHASED FROM FARMERS AND DEALERS, AS REPORTED TO NEW YORK DIVISION OF MILK CONTROL BY 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	Jamestown	Central New York	Capital District	Long Island	All areas
Milk produced	3.80	3.92	3.95	3.96	3.90
Milk purchased from farmers	3.91	4.03	3.91	3.67	3.93
Milk purchased from dealers	3.82	3.80	3.85	3.50	3.83
Total milk supply	3.85	3.93	3.93	3.93	3.91

It was the experience of many of the distributors that they could not hold their customers with milk from an all-Holstein herd. In some markets there has been a decided shift to higher-testing milk. For this reason, many producer-distributors were adding Guernsey cows to their Holstein herds in order to raise the butterfat test of milk produced. Conversely, many distributors said they could not afford to keep an all-Guernsey herd because of the limited outlet for such high-testing milk. Also, many distributors said they could not afford to sell all-Guernsey milk at regular prices, because of the higher cost of production.

Purchase prices or farm value of milk

During the period covered by this survey, the average price to be paid by distributors to producers for milk used for fluid purposes was $2.45 for all upstate New York areas except those where the retail price was less than 12 cents per quart. In such areas the fluid price was $2.30 per hundred pounds. During the same period of time the average price of milk used for fluid cream was $1.73; for milk used for condensed and evaporated milk, $1.48; for milk used for butter, $1.07; and for milk used for American cheese, $1.16 per hundredweight.[6]

Small distributors, including producer-distributors, were required by the Division of Milk Control to pay for at least 75 per cent of their milk at the fluid-milk price, and for the remainder at the fluid-cream price, regardless of the utilization. These percentages are fairly comparable to the actual utilization of milk by the producer-distributors included in this study. The distributors for whom records were analyzed in this study utilized 80 per cent of their milk supply as fluid milk and 20 per cent as cream and by-products.

Some of the larger distributors included in this survey, who were buying large quantities of milk from farmers and were using a larger proportion of it for butter, ice cream, and other by-products, were allowed to pay for milk according to the use made of it, but the quantity paid for at other than fluid-milk or -cream prices was small.

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[6] The minimum prices fixed by the State Division of Milk Control for each class of milk are given in the Appendix, table 76, page 78.

In the upstate areas, the milk produced by the distributor's own herd was valued in accordance with the minimum prices established by the Division of Milk Control. The prices paid by the Long Island distributors for milk purchased were considerably higher than the minimum prices fixed. Accordingly, the milk produced by the herds of these distributors was valued at 7½ cents per quart.

Thus, the farm value or product cost per 100 pounds of milk was about $1.00 higher for the Long Island distributors than for those in the upstate areas. There was little difference between the average prices for the central New York area and the Capital District (table 17). The Jamestown-area price was somewhat lower, because the official price for Class 1 milk in that area was $2.30 per hundred pounds instead of $2.45. The cost of milk purchased from dealers was higher than that purchased from farmers, because some of this milk was processed by the seller. The cream prices were close to 50 cents a quart in all sections.

TABLE 17. AVERAGE PRICES FOR MILK PRODUCED AND MILK AND CREAM PURCHASED BY 92 PRODUCER-DISTRIBUTORS IN DIFFERENT SECTIONS OF NEW YORK STATE, 1935–36

Product and source	Jamestown	Central New York	Capital District	Long Island	All areas
Milk produced (price per 100 pounds, dollars)	2.28	2.45	2.50	3.49	2.62
Milk purchased from farmers (price per 100 pounds, dollars)	2.33	2.44	2.37	3.88	2.40
Milk purchased from dealers (price per 100 pounds, dollars)	2.72	2.61	2.46	4.22	2.87
Cream purchased (price per quart, cents)	48	53	52	54	51

Milk loss

Nearly always the quantity of milk equivalent accounted for in sales is less than the amount of recorded production and purchases. There may be inaccuracies in the accounting of sales or inaccuracy in weighing or measuring the quantity received at the plant. Some milk is lost as a result of spillage or leakage in the plant or on the route. A small amount of milk adheres to cans and equipment used in processing. Other small losses may result from evaporation and from shrinkage in the volume of milk when cooled. These losses are small, but they must be considered in determining the spread between the product cost and the sales, or in determining the profit from milk distribution. This shrinkage in actual sales of milk equivalent, as compared to the quantity produced and purchased, amounted to an average of nearly 2½ per cent for the larger distributors interviewed in this study. Many of the smaller distributors kept records of their milk production and purchases, but no record of sales. In such cases, the quantity of milk sold was considered as 97½ per cent of the actual supply. In this study, therefore, milk loss is treated as a product cost rather than as a part of the plant-operating cost.

Seasonal variation

Producer-distributors have a much more even production of milk throughout the year than do the dairy farmers who deliver to country

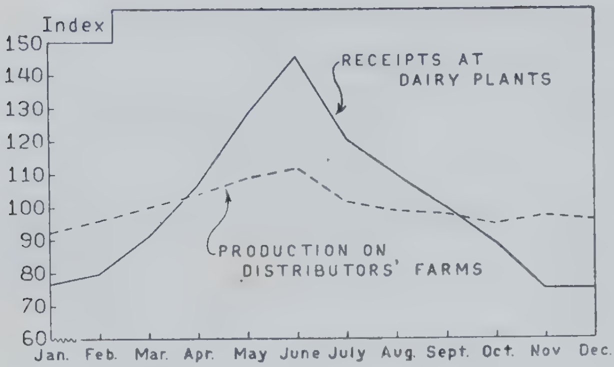

FIGURE 8. SEASONAL RECEIPTS OF MILK AT NEW YORK STATE DAIRY PLANTS AND SEASONAL PRODUCTION BY HERDS, 90 PRODUCER-DISTRIBUTORS, 1935–36
(Daily average for the year = 100)

milk plants (figure 8). The June production for the 90 herds included in this study was only 12 per cent above the average production for the year. For the same month the receipts of milk at all New York State dairy plants were 46 per cent above the average monthly production for the year. The November–June ratio—that is, the November milk production expressed as a percentage of the June production—was 87 per cent for the producer-distributors studied and 51 per cent for all farmers delivering milk to New York State dairy plants during 1936. This is one reason why producer-distributors get a higher return for their milk.

The curve of seasonal production was similar for all the upstate areas. On Long Island, however, the production was lower in the spring months and much higher through the summer months than in the other areas. This is the result of efforts by many of the producer-distributors in that area to adjust their output to the extra demands of resort trade during the summer months. The smaller spring production probably is caused by the small amount of pasture in this area.[7]

There was a greater seasonal variation in the purchases of milk than in the production. The 36 producer-distributors who were purchasing milk made the largest purchases during the months of January, February, and March. With the exception of the Long Island area, a relatively small amount of milk was purchased during the summer months of June, July, and August. In the Long Island area the largest purchases of milk were made during the summer months, and the smallest purchases during the fall and winter months. The heavy purchases of milk during this period, like the production of milk, probably are a reflection of the summer demand caused by an influx of vacation visitors from the metropolitan area.[8]

CAPITAL

Summary of capital requirements

The depreciated value of facilities for distributing milk, together with the amount of accounts receivable, totaled about $4000 per distributor (table 18). These producer-distributors were selling an average of nearly 350 quarts of milk equivalent per day. The total capital invested, therefore, amounted to about $12 per quart of daily sales. About four-fifths of this investment was in physical facilities and supplies used in the distribution of milk, and about one-fifth was in accounts receivable. The original purchase price of equipment and buildings was about 25 to 50 per cent more than the depreciated value.

The largest item of investment was plant equipment, which constituted about 40 per cent of the total. Other items, in order of importance, were buildings, accounts receivable, delivery trucks and automobiles, and containers.

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[7] Data are given in the Appendix, table 77, page 79.
[8] Data are given in the Appendix, table 78, page 79.

TABLE 18. CAPITAL INVESTED IN FACILITIES FOR PROCESSING AND DISTRIBUTING MILK AND IN ACCOUNTS RECEIVABLE, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	Amount per distributor	Amount per quart of daily sales	Proportion of total capital
	Dollars	*Dollars*	*Per cent*
Buildings	986	2.84	24.4
Plant equipment	1,624	4.68	40.2
Containers	162	0.47	4.0
Delivery trucks and automobiles	447	1.29	11.1
Accounts receivable	809	2.33	20.0
All other	14	0.04	0.3
Total capital	4,042	11.65	100.0

Comparison of capital invested by distributors of raw and of pasteurized milk

The total capital invested by the distributors of pasteurized milk was about three and one-third times larger than that invested by the distributors of raw milk (table 19). The greatest differences were found in the investment in plant equipment and in accounts receivable. Both of these items were four times greater for the distributors of pasteurized milk than for the raw-milk distributors. The investment in containers was about three and one-third times larger, and the investment in buildings and delivery trucks about two and one-half times larger, for the distributors of pasteurized milk than for the raw-milk distributors. Since the sales volume of the pasteurizing distributors was only about two and one-half times that of the raw-milk distributors, the total investment per quart was somewhat larger for the pasteurizing distributors.

TABLE 19. CAPITAL INVESTED BY DISTRIBUTORS OF RAW MILK AND DISTRIBUTORS OF PASTEURIZED MILK IN FACILITIES FOR PROCESSING AND DISTRIBUTING MILK AND IN ACCOUNTS RECEIVABLE, 1935–36

Item	41 distributors of raw milk			51 distributors of pasteurized milk		
	High*	Low†	Average	High*	Low†	Average
	Amount per distributor (dollars)					
Buildings	3,998	......	535	8,262	50	1,348
Plant equipment	3,562	......	594	16,284	......	2,453
Containers	420	6	71	2,070	14	236
Delivery trucks and automobiles	869	12	233	2,822	16	617
Accounts receivable	2,000	......	311	12,426	......	1,210
Other	46	......	1	574	......	25
Total capital	8,351	189	1,745	42,438	798	5,889
	Amount per quart (dollars)					
Buildings	10.87	......	3.02	14.18	0.15	2.79
Plant equipment	20.12	......	3.35	34.22	......	5.07
Containers	2.00	0.07	0.40	1.34	0.13	0.49
Delivery trucks and automobiles	5.75	0.26	1.32	5.14	0.12	1.29
Accounts receivable	13.61	......	1.75	16.47	......	2.50
Other	0.06	......	0.01	0.45	......	0.03
Total capital	33.23	1.01	9.85	45.65	3.69	12.17

*Largest amount for any distributor.
†Smallest amount for any distributor.

In general, the plant equipment and milk-room layout of the raw-milk distributors were much simpler. The plant equipment consisted mainly of a hand bottle filler, hand bottle capper, surface cooler, wash tanks, bottle brush, and sometimes a refrigerator (table 20). Since the raw milk was bottled in the morning and distributed almost immediately on the route, refrigeration by mechanical means or with ice was not necessary. Those distributors who lacked this facility used cold-water tanks instead.

TABLE 20. AVERAGE DEPRECIATED VALUES OF THE SEVERAL ITEMS OF PLANT EQUIPMENT AND NUMBER OF DISTRIBUTORS HAVING EACH ITEM OF EQUIPMENT, 89 PRODUCER-DISTRIBUTORS, 1935–36

Item of equipment	41 distributors of raw milk		48 distributors of pasteurized milk	
	Distributors owning each item	Average value*	Distributors owning each item	Average value
	Number	*Dollars*	*Number*	*Dollars*
Ice machine†	17	420	44	460
Brine pump and tank	..	..	40	102
Refrigerator room	25	132	48	247
Pasteurizer	..	..	48	563
Cooler for pasteurized milk	..	..	48	125
Milk pump	..	..	32	36
Sanitary pipe	..	..	48	39
Bottle filler	34	51	48	192
Bottle capper (hand)	20	18	16	26
Steam boiler	28	88	48	179
Bottle washer	34	51	45	148
Sterilizer	9	35	15	101
Separator	23	44	40	95
Cooler for raw milk (surface)	25	24	31	25
Crate trucks	..	..	28	24
Churn	..	..	8	10
Milk-storage tank	..	..	3	116
Laboratory equipment	4	96	16	98
Water pump	24	120	38	82
Other equipment	14	62	38	83

*Detailed value for each item of equipment not available for all distributors.
†Includes only compressor, motor, and accessories.

In general, the pasteurizing distributor had more elaborate equipment. It consisted of a pasteurizer, bottle filler and capper (usually mechanically operated), milk pump, sanitary pipe, a surface cooler to cool the milk after it came from the pasteurizer, and a surface cooler to cool the raw milk as it was milked. A few had ice refrigerators, but most pasteurizing distributors had small refrigeration plants to cool the refrigerator rooms. The capacity of many of the compressors was large enough to enable the distributor to make all the ice he needed on the route. A brine tank and brine pump were standard equipment with most distributors who had a refrigeration plant. Usually the cooler had water in the upper coils and brine in the lower coils. Brine usually is necessary in the lower coils of the cooler for pasteurized milk in order to reduce the temperature to 40° F. or below. The small coolers for cooling the milk as it came from the dairy were operated by water pumped direct from the well. The well usually was located in or near the milk plant so that the water would have less chance of warming before it was used. In addition to the above-mentioned equipment, there were also a bottle washer and sterilizer, a steam boiler, and miscellaneous equipment such as bottle brushes, steam hoses, and the like. The milk was pasteurized in the morning, bottled, and held in the refrigerator room until the following morning, when it was delivered to the customers. The bottles usually were washed after the pasteurizing and bottling was done and after the delivery man returned from the route.

The milk room of many distributors of raw milk was no larger than the milk houses on farms where the milk was sold to country plants. Many of the raw-milk distributors formerly sold to country plants and were able, with little remodeling, to continue to use the same milk house. The average depreciated value of buildings was $535 per distributor for the 41 distributors of raw milk (table 19).

The average building investment of the 51 distributors of pasteurized milk amounted to $1348 per distributor. Since three of these men did not operate plants, the average investment of those who did was about $1432. The buildings were generally of frame construction with concrete floors and fireproof roof. In some instances the milk plant was connected directly with the cow barn. Such an arrangement, though frequently not permitted by the local board of health, usually makes for a more economical use of labor.

The investment in accounts receivable amounted to $2.50 per quart of daily sales for the distributors of pasteurized milk, as compared with $1.75 for the distributors of raw milk (table 19). Many of the small pasteurizing distributors who have recently changed from selling raw milk to selling pasteurized milk have been forced to obtain a larger volume of sales in order to offset the additional cost of pasteurizing. Because of this pressure to get business, some of these distributors have had a very liberal credit policy.

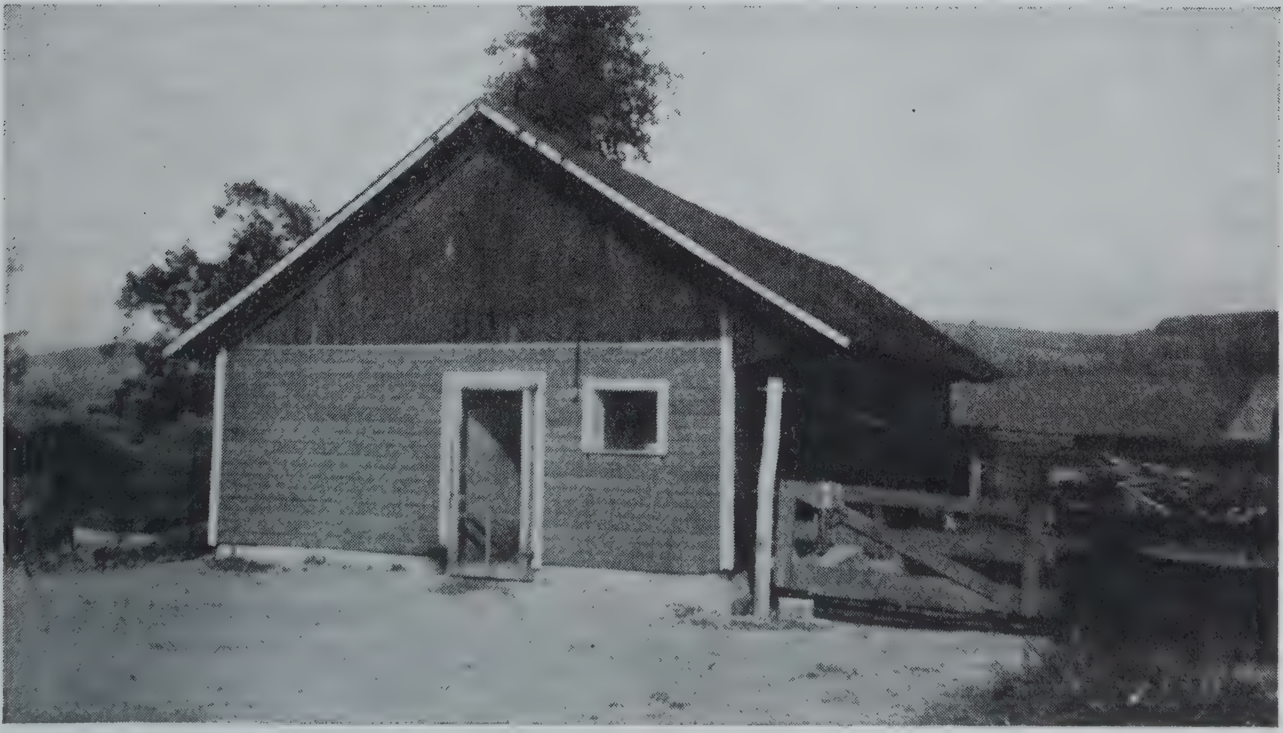

FIGURE 9. MILK PLANT OF A PASTEURIZING DISTRIBUTOR WITH A SMALL VOLUME OF BUSINESS

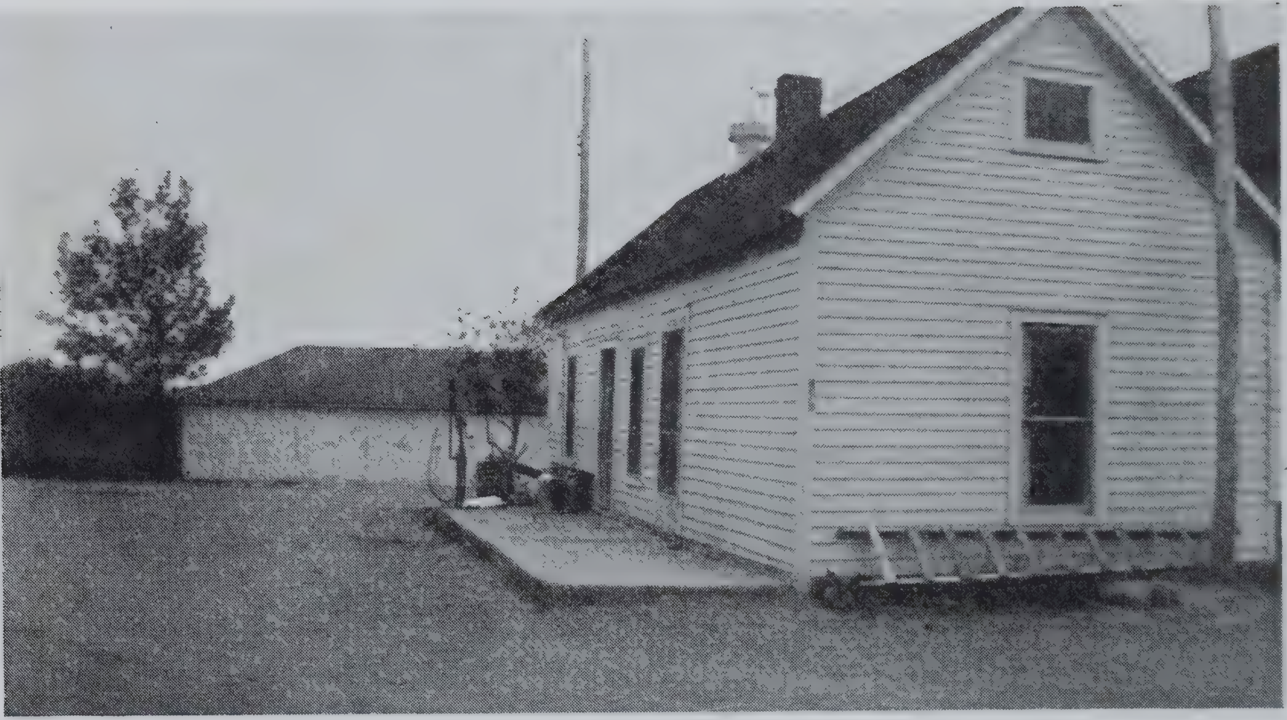

FIGURE 10. MILK PLANT OF A RAW-MILK DISTRIBUTOR

The average depreciated value of delivery trucks and automobiles amounted to $233 per distributor for the raw-milk distributors and $617 for the pasteurizing distributors (table 19). Because of the difference in volume of business, there was little difference in the investment per quart in trucks and automobiles for the two groups of distributors. The average value of 114 milk trucks amounted to $367 per truck. The value of trucks operated by pasteurizing distributors was higher than that of the trucks operated by the raw-milk distributors because, generally, they used larger and more expensive trucks and bought new trucks more often.

The investment in bottles, bottle crates, bottle caps, and cans used for wholesale milk deliveries amounted to an average of only about 40 to 50 cents per quart of daily sales for the two groups of distributors. The distributors of pasteurized milk usually had about four sets of bottles and two sets of cases. Because raw-milk distributors did not have to hold the milk for a day in the cooler, they had fewer bottles and usually only one set of cases. The investment in milk cans was relatively small for both types of distributors. Most of the milk cans were considered as equipment for the farm end of the business.

As previously stated, the actual purchase price of many of the items of plant and equipment would be considerably higher than the values given. In addition to the investments discussed, there is also a cash reserve necessary in order to keep the business running smoothly, but no information was obtained concerning the amount of cash balance carried by the distributors interviewed.

The producer-distributors have a considerable amount of money invested in good will. Estimates obtained from 65 distributors placed the good-will value of their businesses at $1893 (table 21). The average daily volume of these 65 distributors amounted to 369 quarts of milk equivalent. On the basis of daily sales, the good-will value of these businesses amounted to about $5.00 per quart. Thirty-seven of the dis-

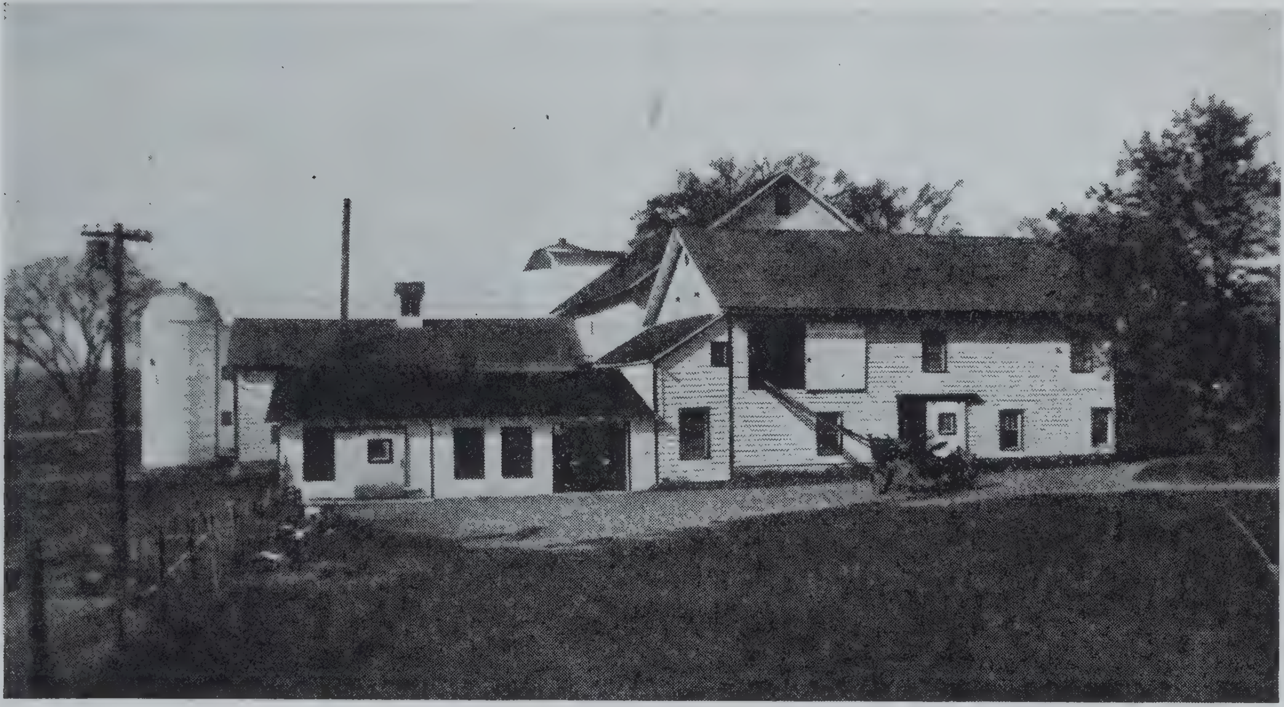

FIGURE 11. PASTEURIZING PLANT OF THE DISTRIBUTOR WHOSE BARNS ARE PICTURED IN FIGURE 6

The milk plant and the garage are attached to the barn

tributors interviewed had purchased milk routes, and, in some instances, the entire business of a small distributor. The net cost of good will, after deducting from the purchase price the estimated value of equipment purchased with the business, amounted to $1024 per distributor, or about $3.50 per quart of milk equivalent. The good-will values, based both on estimates and on actual purchases, were lower for the distributors of raw milk than for the distributors of pasteurized milk. The good-will values are an indication of the cost of getting established in business, in addition to the necessary investment in physical facilities. Thus the good-will item may represent the actual cost of good will purchased or the estimated cost of gradual acquisition of customers.

The producer-distributors in the upstate New York areas had considerably more capital invested than had those in the Long Island area.

TABLE 21. VALUES OF GOOD WILL FOR A SELECTED NUMBER OF PRODUCER-DISTRIBUTORS, 1935–36

Item	Distributors of raw milk	Distributors of pasteurized milk	All distributors
Data based on operator's estimates:			
Number of estimates obtained	27	38	65
Estimated good-will value per distributor (dollars)	708	2,734	1,893
Daily volume of business (quarts milk equivalent)	163	515	369
Estimated good-will value per quart (dollars)	4.34	5.31	5.13
Data based on actual purchases:			
Number of distributors buying business	12	25	37
Total cost per distributor (dollars)	456	1,896	1,429
Value of equipment included in purchases (dollars)	177	515	405
Net cost of good will (dollars)	279	1,381	1,024
Daily volume of business (quarts milk equivalent)	168	354	294
Good-will cost per quart (dollars)	1.66	3.90	3.48

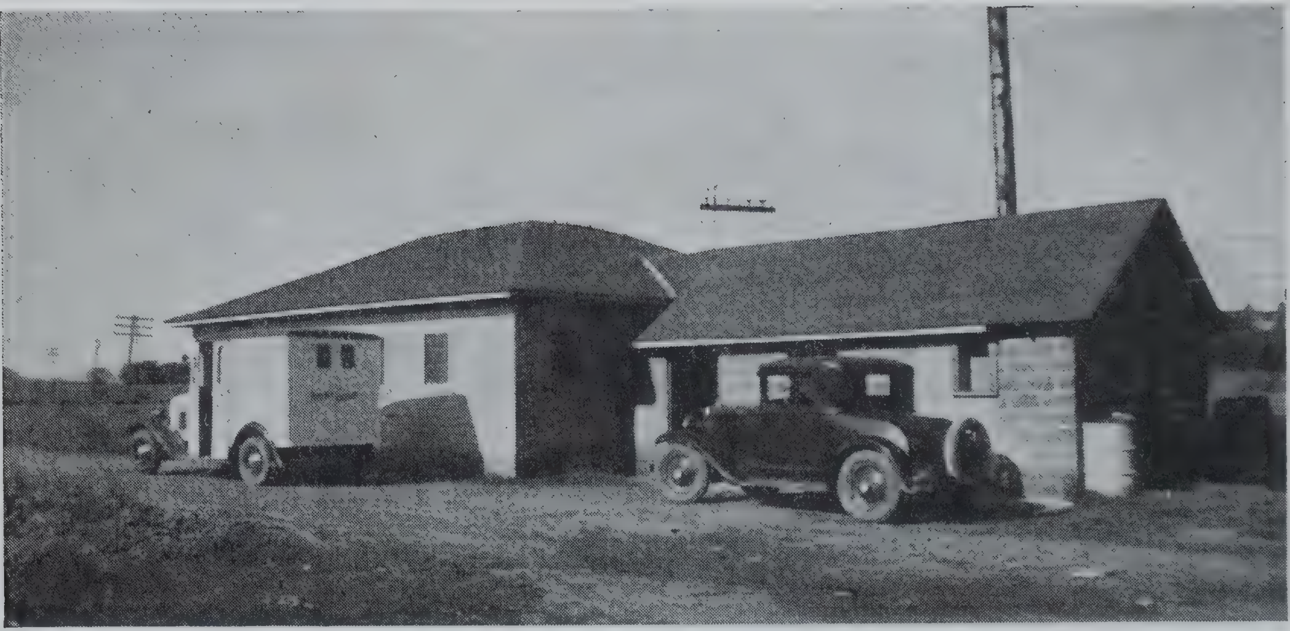

FIGURE 12. PASTEURIZING PLANT THAT WAS CONVERTED FROM A RAW-MILK PLANT

The cement-block building was formerly the raw-milk plant; the frame addition was built to make room for pasteurizing equipment and a new refrigerator plant. The original building is now used as a boiler and storage room. The owner of this plant had too large an investment for the volume of milk handled

This difference in the capital invested per producer-distributor in the different areas is largely a reflection of the proportion of raw-milk distributors operating in each area and of the volume of business of the distributors in the area. The smallest total investment was found in the Long Island area, and the largest total investment in the central New York area. On a per quart basis, the smallest investment was found in the Capital District, and the largest in the central New York area.

Cost of changing a raw-milk plant to a pasteurizing plant

Forty-seven of the 51 pasteurizing distributors included in this survey had changed from raw milk to pasteurized milk. Of this number, 19 had made the change in preparation for selling pasteurized milk during the year 1935. Data were obtained from 33 of the distributors that had made the change recently. The cost of purchasing and installing the added equipment necessary for pasteurizing milk amounted to about $1900. Of this amount, $732 was for the purchase and installation of the pasteurizer and thermometers, $265 for coolers, milk pump, and sanitary pipe, $484 for refrigeration equipment, $141 for bottle capper and filler, and $290 for other incidental purchases. The 21 distributors from whom data were obtained on the costs of changing the building from a raw-milk to a pasteurizing plant spent about $1000 in addition to their own labor. About three-fourths of this was for materials, and about one-fourth for labor hired. The labor charge would be 50 per cent or more of the total if the operators had hired all of the labor. With city wages still relatively high as compared with farm wages, many of the producer-distributors found it economical to hire as little labor for building as possible. Some of these distributors have constructed their own cold rooms. One very satisfactory and inexpensive cold room was made out of cement blocks and three layers of fiber board with an air space between each layer. The work was done entirely by the operator. The total cost for materials was about $100.

The cost of changing to pasteurized milk entailed more expense for the small raw-milk distributors than for the larger ones because the increase in volume necessary to operate a pasteurizing plant efficiently made it necessary to replace much of the old equipment and increase the size of the building previously used. In many cases it was necessary to put up a new building. The raw-milk distributor with less than average volume should thoroughly consider the possibility of hiring his processing and bottling done before deciding to install pasteurizing equipment.

Some of the distributors found it necessary to purchase a larger truck in order to distribute the larger volume of milk handled after the change from raw to pasteurized, but no data were obtained on the costs other than those of changing the plant from a raw-milk plant to a pasteurizing plant.

OPERATING COSTS[9]

Summary of costs by departments

The total cost of handling, processing, and distributing milk by the 92 producer-distributors during a 12-months period in 1935–36 amounted to approximately 4 cents per quart of milk equivalent (table 22). One-half this expense was for selling and delivery costs, which include the direct truck and labor cost for delivery, and other items, such as bad debts, advertising, licenses, and permits. These items of expense amounted to $2569 per distributor, or about 2 cents per quart of milk equivalent sold.

TABLE 22. COST OF HANDLING, PROCESSING, AND DISTRIBUTING MILK BY 92 PRODUCER-DISTRIBUTORS, 1935–36

Cost classification	Amount per distributor	Amount per quart*	Proportion of total
	Dollars	*Cents*	*Per cent*
Plant	1,907	1.50	37.2
Container	346	0.27	6.7
Selling and delivery	2,569	2.02	50.1
Administrative	306	0.24	6.0
Total	5,128	4.03	100.0

*Computed on the basis of milk equivalent of milk, cream, and other products. Whole milk constituted about 80 per cent of the total volume.

With the exception of container costs, all of the expense of handling and preparing the milk for sale, from the time it was received in the milk room until it was taken out of the cooler and set on the delivery truck, was classified as plant expense. Items of expense so classified amounted to $1907 per distributor, or 1.5 cents per quart of milk sold, and constituted slightly more than one-third of the total cost of distribution.

Container costs include the expense for bottles, bottle caps, bottle crates, and milk cans used for wholesale bulk delivery. These items amounted to $346 per distributor, or about one-fourth cent per quart of milk sold.

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[9] Operating cost is made up of all costs of doing business other than the product cost. The cost of doing custom work for others, such as bottling and pasteurizing, is included. These costs are made up of direct cash outlays as well as non-cash items such as unpaid labor, depreciation, interest on the investment, and the like. Interest on total investment was calculated at 5 per cent. Unpaid labor was charged at the estimated cost of an equivalent amount and quality of hired labor receiving similar privileges.

General administrative expenses for bookkeeping, office supplies, legal work, and operator's management, and the like, amounted to $306 per distributor, or about one-fourth cent per quart of milk sold.

Differences in operating costs for raw-milk distributors and pasteurizing distributors

The foregoing cost figures are averages for both producer-distributors selling raw milk and pasteurizing distributors. On a quart basis, there was little difference between the costs of the two types of distributors. The total cost per quart was 0.4 cent less for distributors selling pasteurized milk than it was for distributors selling raw milk (table 23).

TABLE 23. COST OF DISTRIBUTION CLASSIFIED BY DEPARTMENTS, 41 DISTRIBUTORS SELLING RAW MILK AND 51 DISTRIBUTORS SELLING PASTEURIZED MILK, 1935–36

Cost classification	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
	Amount per distributor		
	Dollars	*Dollars*	*Dollars*
Plant	960	2,669	1,907
Container	197	465	346
Selling and delivery	1,501	3,427	2,569
Administrative	172	414	306
Total	2,830	6,975	5,128
	Amount per quart		
	Cents	*Cents*	*Cents*
Plant	1.48	1.51	1.50
Container	0.30	0.26	0.27
Selling and delivery	2.31	1.94	2.02
Administrative	0.27	0.23	0.24
Total	4.36	3.94	4.03

Practically all of this difference was due to the higher delivery cost of the raw-milk distributors. Pasteurizing distributors had the advantage of a larger volume per route. The additional expense of the pasteurizing distributors for plant equipment and labor for pasteurizing, was entirely offset by the increase in efficiency due to handling a much larger volume of milk. The total cost per plant for pasteurizing plants was two and one-half times that of the raw-milk plants, whereas the volume was 2.7 times larger than that of the raw-milk plants. As a result of using more labor-saving devices such as mechanical bottlers and bottle washers, the pasteurizing plants required less labor per quart of milk processed than was used in the raw-milk plants.

When a producer-distributor installs pasteurizing equipment, it is necessary for him to build up a larger volume of business in order to keep his plant costs down to a reasonable rate per quart. He may continue to operate only one route for distributing the larger volume of milk, and this will result in more efficient use of delivery labor and equipment.

Summary of costs by type of expenditure

When all the costs for the entire distribution enterprise are classified by type of expenditure, labor is found to be the largest single item of expense (table 24). This amounted to a total of $2359 per distributor, or nearly 2 cents per quart of milk equivalent. The total amount of labor used during the year amounted to 6213 hours per distributor. This was equivalent to the time of two men, each working eight and one-half hours per day for a year. Of the total labor, 57 per cent was hired, 28 per cent was performed by the operator, and about 15 per cent was performed by other unpaid family help. The amount of labor used on the route was more than half the total labor employed.

TABLE 24. ANALYSIS OF COSTS BY TYPE OF EXPENDITURE, AND BY DEPARTMENTS, 92 PRODUCER-DISTRIBUTORS, 1935–36

Type of expenditure	Plant	Container	Selling and delivery	Adminis-trative	Total
	Amount per distributor				
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Labor	839	...	1,300	220	2,359
Supplies and purchased services	465	338	430	86	1,319
Depreciation and repairs	387	...	320	...	707
Interest	130	8	64	*	202
Taxes	16	...	89	*	105
Insurance	16	...	50	*	66
General expenses	54	...	316	...	370
Total	1,907	346	2,569	306	5,128
	Amount per quart				
	Cents	*Cents*	*Cents*	*Cents*	*Cents*
Labor	0.66	...	1.02	0.17	1.85
Supplies and purchased services	0.37	0.26	0.34	0.07	1.04
Depreciation and repairs	0.31	...	0.25	...	0.56
Interest	0.10	0.01	0.05	†	0.16
Taxes	0.01	...	0.07	†	0.08
Insurance	0.01	...	0.04	†	0.05
General expenses	0.04	...	0.25	...	0.29
Total	1.50	0.27	2.02	0.24	4.03

*Less than 50 cents.
†Less than 0.005 cent.

Supplies and purchased services were the next most important kinds of expenses, amounting to an average of $1319 per distributor, or about 1 cent per quart. This includes such items as coal, washing powder, gasoline and oil, bottles, bottle caps, office supplies, and the like.

Depreciation and repairs for plant equipment and buildings amounted to $387 per year. The depreciation and repairs on the trucks and automobiles was about the same as that for the plant equipment and buildings. Total depreciation and repairs amounted to $707 per distributor, or about one-half cent per quart of milk equivalent sold.

Interest was charged on buildings, equipment, and supplies at the rate of 5 per cent per year on the average value, and amounted to $202 per distributor for the year.

Taxes amounted to $105 for the year. The prorated share of the total farm taxes was charged to buildings, based on the value of the buildings in relation to the total value of the farm. No taxes were charged on the equipment, except for trucks and automobiles. In this case the license fees were classed as taxes. Other items included were State and municipal license fees, and the State publicity tax on milk sales.

Insurance premiums amounted to $66. This included building and equipment insurance, boiler insurance when carried, and automobile and truck insurance.

Other expenses were classified as general expenses, and amounted to $370, or about one-fourth cent per quart of milk equivalent sold.

Analysis of plant costs

Labor. Wages were by far the most important item of plant costs, amounting to almost 0.7 cent per quart of milk sold (table 25). Wages made up a larger percentage of the total plant expense and were a greater amount per quart for the raw-milk distributors than for the pasteurizing distributors. This probably is due to the greater amount of hand work and less use of labor-saving devices, such as mechanical bottlers and bottle fillers, by the raw-milk distributors.

TABLE 25. ANALYSIS OF PLANT COSTS FOR 92 PRODUCER-DISTRIBUTORS, 1935–36

Cost classification	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
	Amount per distributor		
	Dollars	*Dollars*	*Dollars*
Labor	529	1,089	839
Use of equipment	141	649	422
Heat, light, power	122	430	293
Supplies	86	241	172
Use of buildings	67	175	127
All other *	14	85	54
Total	959	2,669	1,907
	Amount per quart		
	Cents	*Cents*	*Cents*
Labor	0.82	0.62	0.66
Use of equipment	0.22	0.37	0.33
Heat, light, power	0.19	0.24	0.23
Supplies	0.14	0.13	0.14
Use of buildings	0.10	0.10	0.10
All other*	0.01	0.05	0.04
Total	1.48	1.51	1.50

*Includes payment for hired pasteurizing, water rent, etc.

There was a total of 1550 hours of labor per plant for the raw-milk distributors, and a total of 3288 hours per plant for the pasteurizing distributors (table 26). The pasteurizing distributors hired more of their work done than did the raw-milk distributors. With the larger enterprise it usually was necessary to hire one full-time man to handle the delivery route and one man to do the plant work and possibly to help some with the milking. In many of the raw-milk plants all of the route and the plant labor was performed by the operator and his family and the regular hired farm help.

TABLE 26. AMOUNT, COST, AND SOURCE OF PLANT LABOR, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
Total cost (dollars)	529	1,089	839
Total hours	1,550	3,288	2,513
Cost per hour of labor (cents)	34	33	33
Percentage of total hours of plant labor by:			
Operator	37.1	19.7	24.3
Other family help	17.2	13.0	14.1
Hired persons	45.9	67.3	61.6
Total	100.0	100.0	100.0

About two-thirds of the labor used in both the raw-milk and pasteurizing plants was for washing bottles and cans and cleaning equipment and floors (table 27). The washing of bottles and cans was the more important. Bottling required 28 per cent of the total labor in raw-milk plants and only 19 per cent in the pasteurizing plants. As previously stated, more of the pasteurizing distributors used automatic bottle fillers. The job of pasteurizing required about one-eighth of the total plant time. The person who had the responsibility of watching the pasteurizer usually performed other duties, such as washing bottles and cans, while the milk was being held in the pasteurizer. Other operations performed in the plant, such as boiler work, cooling, separating, handling, and packaging by-products used about 10 per cent of the labor in both the raw-milk and pasteurizing plants.

TABLE 27. USE OF PLANT LABOR, 92 PRODUCER-DISTRIBUTORS, NEW YORK STATE, 1935–36

Operation	Percentage of total hours of labor	
	41 distributors of raw milk	51 distributors of pasteurized milk
Washing bottles and cans	41.5	33.0
Cleaning equipment and floors	20.6	24.7
Bottling	28.0	19.1
Pasteurizing	....	12.8
Boiler work	3.0	5.2
Cooling	4.2	2.5
Separating	1.8	1.5
By-products	0.9	1.2
Total	100.0	100.0

Plant equipment. Depreciation was the largest item of plant-equipment expense for both groups of distributors (table 28). This item amounted to an average of $255 per distributor, or 0.2 cent per quart of milk sold. The average depreciation rate was about 15 per cent of the inventory value of equipment in the plant. The average life of plant equipment was about 6 or 7 years. The equipment cost of the pasteurizing distributors was about four and one-half times that of the raw-milk distributors.

Heat, light, and power. The average annual charge for heat, light, and power amounted to $122 per year for the raw-milk distributors, and $430 per year for the pasteurizing distributors (table 29). Electricity

TABLE 28. ANALYSIS OF COSTS FOR PLANT EQUIPMENT USE, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
	Amount per distributor		
	Dollars	*Dollars*	*Dollars*
Cash repairs	19	88	57
Farm labor	2	34	20
Depreciation	88	389	255
Insurance	2	15	9
Interest	30	123	81
Total	141	649	422
	Amount per quart		
	Cents	*Cents*	*Cents*
Cash repairs	0.03	0.05	0.04
Farm labor	*	0.02	0.02
Depreciation	0.14	0.22	0.20
Insurance	*	0.01	0.01
Interest	0.05	0.07	0.06
Total	0.22	0.37	0.33

*Less than 0.005 cent.

TABLE 29. ANALYSIS OF HEAT, LIGHT, AND POWER COSTS, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
	Amount per distributor		
	Dollars	*Dollars*	*Dollars*
Electricity	44	218	141
Coal	39	173	113
Other fuel	39	39	39
Total	122	430	293
	Amount per quart		
	Cents	*Cents*	*Cents*
Electricity	0.07	0.12	0.11
Coal	0.06	0.10	0.09
Other fuel	0.06	0.02	0.03
Total	0.19	0.24	0.23

was the most important item, amounting to $44 for the raw-milk distributors and $218 per year for the distributors of pasteurized milk. Electrical pasteurizers were used in four of the plants. This increased the consumption of electricity and decreased the consumption of coal. The average expense for coal was $113. This ranged from an average of $39 for the raw-milk distributors to $173 for the pasteurizing distributors. Of the 41 raw-milk distributors, 28 were using coal to heat water. These distributors used about six and one-half tons each, at a cost of $9 per ton. The 44 pasteurizing distributors with coal-burning steam boilers used 25 tons each, costing about $7.75 per ton. Three distributors were using oil burners and one was using illuminating gas in the steam boiler. It was the opinion of these men that coal was cheaper than oil or gas. The oil burners also added to the equipment cost.

Supplies. Washing powder was the largest item of plant-supply expense; it amounted to about $21 per year in the raw-milk plants and to nearly $50 per year in the pasteurizing plants (table 30). Ice was more important in the raw-milk plants because of the absence of mechanical refrigeration. Other supply items were chocolate syrup, orange concentrate, aprons, boots, gloves, and the like.

TABLE 30. ANALYSIS OF PLANT SUPPLY COSTS, 92 PRODUCER-DISTRIBUTORS, 1935–36

Cost classification	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
	Amount per distributor		
	Dollars	*Dollars*	*Dollars*
Chocolate syrup	7	88	52
Orange concentrate	...	15	8
Cleaning powder	21	47	36
Ice	38	8	21
Aprons, boots, gloves	4	9	7
Miscellaneous	16	74	48
Total	86	241	172
	Amount per quart		
	Cents	*Cents*	*Cents*
Chocolate syrup	0.01	0.05	0.04
Orange concentrate	...	0.01	0.01
Cleaning powder	0.03	0.03	0.03
Ice	0.06	*	0.02
Aprons, boots, gloves	0.01	...	0.01
Miscellaneous	0.03	0.04	0.03
Total	0.14	0.13	0.14

*Less than 0.005 cent.

Buildings. The total building expense amounted to $129 per year per distributor (table 31). Of this amount, the expense for repairs and depreciation to buildings was $55, or 0.04 cent per quart of milk equivalent. This item was about three times larger for the pasteurizing plants than for the raw-milk plants. Interest on the building investment amounted to $49 per distributor per year.

Analysis of container costs

Expenses for bottles, caps, bottle crates, and milk cans make up the total cost of $346 per distributor, or about 0.03 cent per quart of milk equivalent sold. There was little difference in the container cost per quart for the raw-milk distributors and for the pasteurizing distributors.

Bottles. Most of the containers for milk were glass bottles bearing the distributor's name. In a very few instances, no name was placed on the bottle. Store bottles were not generally used, and in only a few markets were bottle deposits required.

Savings of considerable amount could be made in wholesale distribution if a bottle deposit were charged on all bottles used in store trade.

TABLE 31. ANALYSIS OF COSTS FOR BUILDING USE, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
	Amount per distributor		
	Dollars	*Dollars*	*Dollars*
Cash repairs	11	35	24
Farm labor	2	25	15
Depreciation	11	19	16
Insurance	3	11	7
Taxes	8	23	16
Interest	27	67	49
Rent	5	. . .	2
Total	67	180*	129†
	Amount per quart		
	Cents	*Cents*	*Cents*
Cash repairs	0.02	0.02	0.02
Farm labor	‡	0.01	0.01
Depreciation	0.02	0.01	0.01
Insurance	‡	0.01	0.01
Taxes	0.01	0.01	0.01
Interest	0.04	0.04	0.04
Rent	0.01	. . .	‡
Total	0.10	0.10	0.10

*Of this amount, $175 was charged to plant expense and $5 to delivery expense for space used to store trucks.

†Includes $2 per year which was charged to delivery expense.

‡Less than 0.005 cent.

Many of the pasteurizing distributors were using the pyro-glaze bottle, which costs $10 to $11 per gross for the quart size. Most of these distributors believed that the advertising value of these bottles and their

FIGURE 13. MILK ROOM OF ANOTHER PASTEURIZING DISTRIBUTOR

More than 2000 quarts of milk a day were pasteurized and bottled in this plant. The distributor did a large amount of custom work to reduce his plant costs effect in reducing bottle losses were sufficient to more than offset the added cost. One distributor used paper containers for wholesale sales of cream to stores. In no other instances were paper containers used.

The expenditure for bottles purchased or used from inventories, plus the cost of bottles returned from the bottle exchanges, and interest on the investment in bottles, amounted to $189 per distributor (table 32). An average of 21 gross of bottles costing about $8 per gross was used. The loss and breakage, therefore, were about 8 bottles per day in addition to the bottles recovered through the bottle exchanges. Fifty-eight of the 92 producer-distributors patronized bottle exchanges at a cost of about $2.30 per month. An average of nearly 330 bottles of all sizes were used daily in distributing 347 quarts of milk equivalent, the average volume for all distributors in the study. Since 8 bottles were lost or broken on the average for each 330 delivered, the average life of a bottle was approximately 40 trips. Most of the small distributors were personally acquainted with their customers and lost very few bottles.

TABLE 32. ANALYSIS OF CONTAINER COSTS FOR 92 PRODUCER-DISTRIBUTORS, 1935–36

Cost classification	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
	Amount per distributor		
	Dollars	*Dollars*	*Dollars*
Bottle expense	100	261	189
Bottle caps	90	172	136
Bottle crates	7	28	19
Cans*	†	4	2
Total	197	465	346
	Amount per quart		
	Cents	*Cents*	*Cents*
Bottle expense	0.16	0.15	0.15
Bottle caps	0.13	0.10	0.11
Bottle crates	0.01	0.01	0.01
Cans*	‡	‡	‡
Total	0.30	0.26	0.27

*Expense for cans for milk sold in bulk.
†Less than 50 cents.
‡Less than 0.005 cent.

Bottle caps. Plug-style bottle caps were generally used by the producer-distributors interviewed in this study, but premium grades of milk usually were put up with the more expensive hood, or lip, cap. A few distributors were using aluminum caps, but thought they were expensive. Also there were a few complaints that these caps had a tendency to leak, particularly when the milk warmed up after it was taken out of the cooler.

On the average, 158,000 caps, costing about 85 cents per thousand, were used per distributor per year. The cost of caps varied from 50 cents to $1.00 per thousand for plug caps, and from $2.50 to $2.75 per thousand for the hood, or lip, caps. The use of the more expensive cap increases the cost of a quart of milk about one-fourth of a cent. The total cost for bottle caps amounted to $136 per distributor per year, or about 0.1 cent per quart of milk sold (table 32).

Bottle crates. An average of about 50 bottle crates, worth about $1.00 each at depreciated values, were kept by the distributors interviewed. An average of 11 crates, costing nearly $2.00 apiece, were purchased during the year. The total cost of bottle crates, including interest on the investment and crates purchased less inventory increases, amounted to an average of $19 per distributor per year (table 32).

Analysis of selling and delivery costs

Labor. Selling and delivery costs, which constituted half of the total cost of distribution, were about half made up of labor charges (table 33).

TABLE 33. ANALYSIS OF SELLING AND DELIVERY COSTS FOR 92 PRODUCER-DISTRIBUTORS, 1935–36

Cost classification	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
	Amount per distributor		
	Dollars	*Dollars*	*Dollars*
Labor	780	1,719	1,300
Truck	436	1,047	775
Automobile	25	64	47
Bad debts	169	436	267
Licenses, permits, etc	39	73	58
Interest on slow accounts	16	61	41
Advertising	13	48	32
Ice	23	30	27
All other	*	39	22
Total	1,501	3,427	2,569
	Amount per quart		
	Cents	*Cents*	*Cents*
Labor	1.20	0.97	1.01
Truck	0.67	0.59	0.61
Automobile	0.04	0.04	0.04
Bad debts	0.26	0.20	0.21
Licenses, permits, etc	0.06	0.04	0.05
Interest on slow accounts	0.02	0.03	0.03
Advertising	0.02	0.03	0.03
Ice	0.04	0.02	0.02
All other	†	0.02	0.02
Total	2.31	1.94	2.02

*Less than 50 cents.
†Less than 0.005 cent.

The amount of labor used for selling and delivery was about equal to one man's work for 9 hours per day. Nearly 40 quarts of milk equivalent were sold for each hour of labor spent in delivery and collection. With labor at 40 cents an hour, the labor cost for selling and delivery is about one cent per quart of milk sold. About 90 per cent of this labor was used in delivery operations and about 10 per cent for time spent in making collections, soliciting new customers, and in checking sales and collection records at the office.

There is little difference between the raw-milk distributors and the distributors of pasteurized milk as to the cost of labor, but there is considerable difference in the source of the labor (table 34). The operators

TABLE 34. AMOUNT, COST, AND SOURCE OF SELLING AND DELIVERY LABOR, 92 PRODUCER-DISTRIBUTORS, 1935–36

Cost classification	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
Total cost (dollars)	780	1,719	1,300
Total hours	2,018	4,329	3,300
Cost per hour of labor (cents)	39	40	39
Percentage of total hours of selling and delivery labor by:			
Operator	48.8	21.1	28.1
Other family help	11.6	15.7	14.6
Hired persons	39.6	64.2	57.3
Total	100.0	100.0	100.0

of the raw-milk businesses performed half of the delivery and selling work and hired about one-third done, whereas the producer-distributors selling pasteurized milk performed only one-fifth of the delivery and selling work and hired about two-thirds done. The remainder of the work was done by unpaid family labor. The operators of many of the small raw-milk businesses did all the delivery work themselves. In many cases, the son made the deliveries. This work, if paid for, was considered as hired and not as family help.

Trucks and automobiles. Truck costs were next in importance and made up 30 per cent of the total selling and delivery costs. Trucks were driven an average of nearly 47 miles per day per distributor for delivery and collection purposes, at a cost of a little over 4.5 cents per mile. With an average of 347 quarts of milk sold per day, this amounts to approximately 7 quarts of milk sold per mile of route. In addition, the operator's automobile was driven about 25 miles per week for delivery work and collection of milk accounts.

The total annual cost of operating 114 milk-delivery trucks amounted to about $700 per year (table 35). Of this amount about 90 per cent was charged to the retail milk business and the balance was charged to the farm for such use as hauling feed and other miscellaneous work. The 114 milk-delivery trucks on which detailed records were kept were driven about 15,458 miles per year at a cost of 4.53 cents per mile. An average of about 10 miles per gallon of gasoline was obtained for all the driving. With an average of 246 quarts delivered per truck per day the average truck cost was about 0.7 cent per quart. The largest items of expense were for gasoline, depreciation, and repairs.

The trucks operated by the raw-milk distributors were cheaper, as is indicated by the lower inventory value. Since they were driven the same number of miles as were the 74 trucks operated by the pasteurizing distributors, and since the total cost was less, the cost per mile was only 3.67 cents. This compares with 5.01 cents per mile for the 74 trucks operated by the distributors of pasteurized milk.

Most of the raw-milk distributors used trucks with uncovered express bodies so that the truck would be more useful for general farm work. Some of the larger pasteurizing distributors were also using express rather than closed bodies because they could carry larger loads of milk and the route man could deliver more rapidly. A few of the pasteurizing

TABLE 35. TRUCK EXPENSE FOR 86 PRODUCER-DISTRIBUTORS, 1935–36

Item	36 distributors of raw milk	50 distributors of pasteurized milk	86 distributors
Number of trucks	40	74	114
Average value per truck (dollars)	282	413	367
Miles driven per year	15,765	15,291	15,458
Miles per gallon of gasoline	10.5	9.6	9.9
Total truck cost per mile (cents)	3.67	5.01	4.53
Per cent of total cost charged to milk distribution	77.4	94.2	89.3
Average size of load (quarts daily)	165	290	246
Cost per quart of milk sold (cents)*	0.74	0.68	0.70
Average cost of operation per truck:			
Cash expenses (dollars):			
Gasoline	258.00	278.19	271.11
Repairs	84.58	135.00	117.31
Insurance	34.63	46.01	42.02
Oil and grease	24.42	33.54	30.34
License	23.15	27.26	25.82
All other	4.42	17.73	13.06
Non-cash items (dollars):			
Interest	14.15	20.59	18.33
Depreciation	108.20	179.64	154.57
All other	26.68	28.20	27.67
Total expense (dollars)	578.23	766.16	700.23

*Includes only milk sold on the route.

distributors were using trucks built especially for retail delivery work. One of this type is shown in figure 15. The operation of a truck of this type is more expensive because of the high purchase price and because it does not carry so large a load as does one with an express body. Many distributors favor this type of body because it protects the load from the weather and also is easier for the driver to operate since he can drive in a standing position.

Of the distributors interviewed, 36 were using their automobiles for

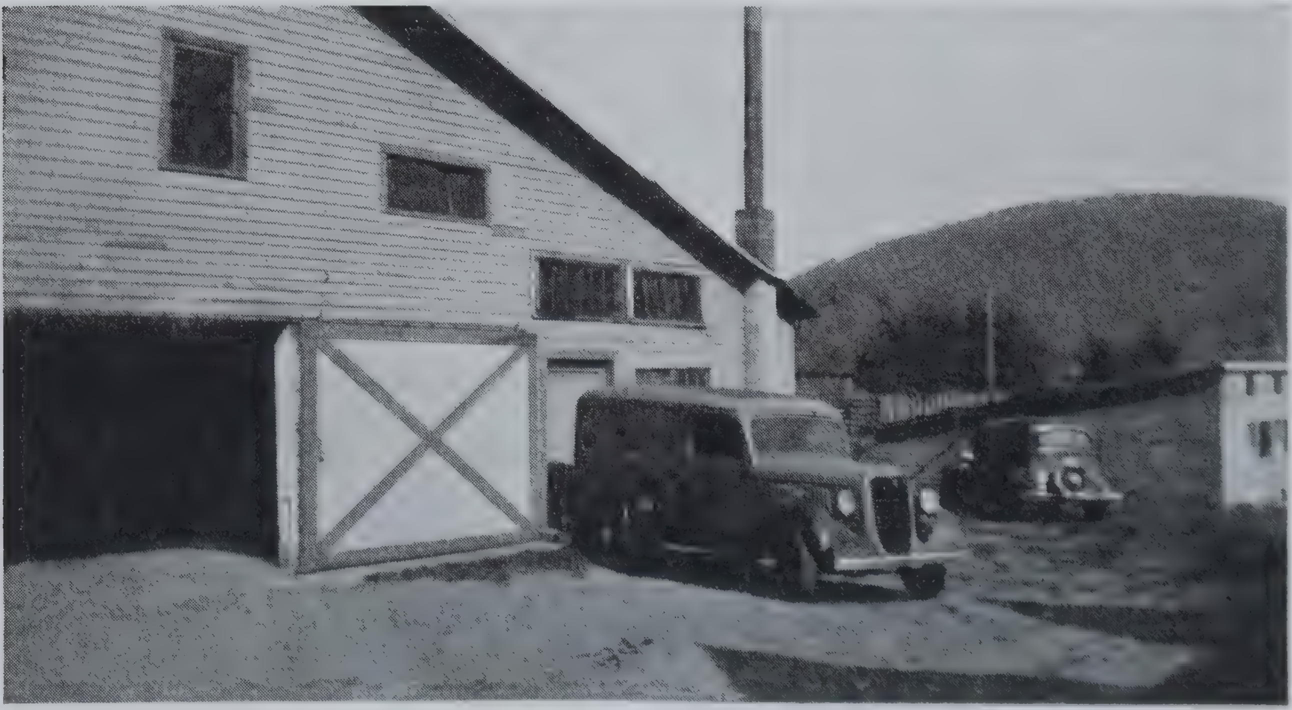

FIGURE 14. DELIVERY TRUCK WITH A PANEL-TYPE BODY

Except for the express body, this type of truck was used by most distributors for deliveries

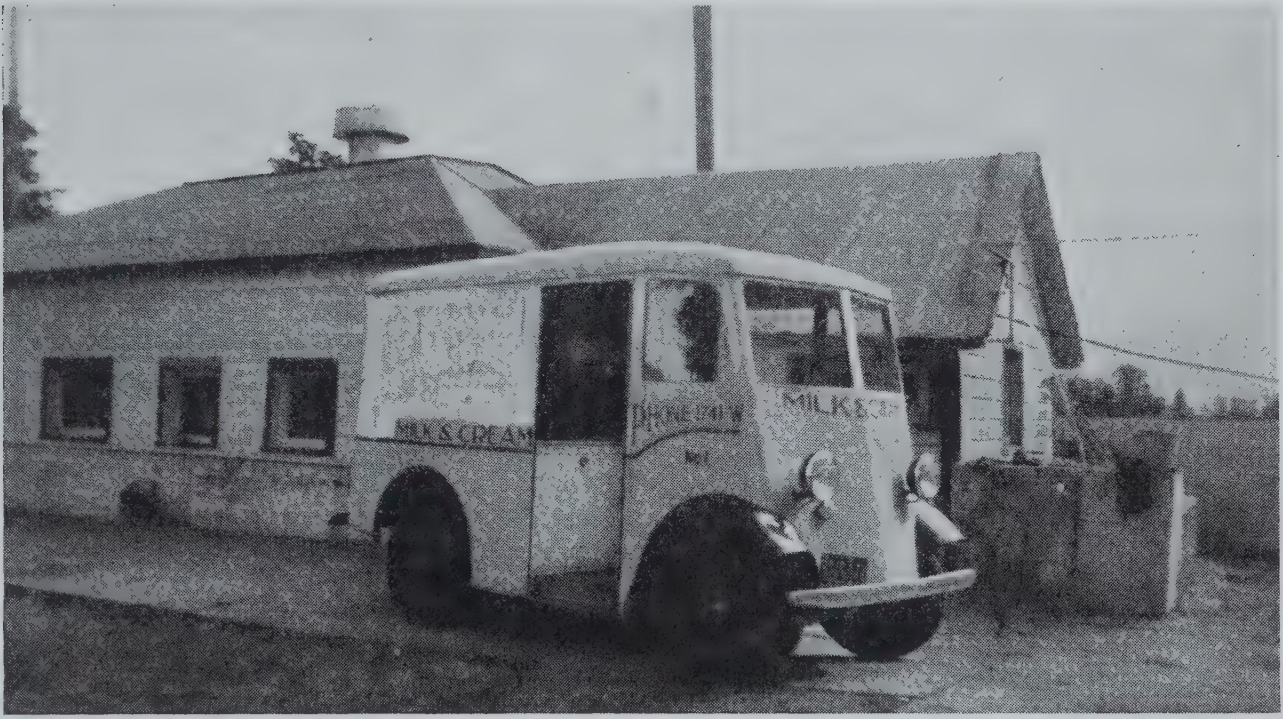

FIGURE 15. TRUCK BUILT ESPECIALLY FOR RETAIL DELIVERIES
This truck, although convenient to use, is expensive to operate. The purchase price is nearly double that of the truck shown in figure 14

some part of the distribution work. Five were using the automobile for regular delivery work. The other automobiles were used for special deliveries, collection work, and for work in connection with managing and overseeing the business.

The average annual cost of operation of the 32 automobiles on which records were obtained was $405 per year, or 3.86 cents per mile (table 36).

TABLE 36. AUTOMOBILE EXPENSE FOR 32 PRODUCER-DISTRIBUTORS, 1935–36

Item	8 distributors of raw milk	24 distributors of pasteurized milk	32 distributors
Number of automobiles	8	24	32
Average value per automobile (dollars)	275	306	298
Miles driven per year	7,600	11,453	10,490
Miles per gallon of gasoline	12.0	14.2	13.8
Total cost per mile (cents)	4.40	3.74	3.86
Per cent of use charged to milk distribution	39.1	35.8	36.5
Average cost of operation per automobile:			
Cash expenses (dollars):			
Gasoline	105.62	138.96	130.62
Repairs	30.50	69.33	59.62
Insurance	41.50	31.21	33.78
Oil and grease	13.75	24.33	21.69
License	17.38	14.87	15.50
All other	2.75	3.58	3.38
Non-cash items (dollars):			
Interest	13.75	15.29	14.91
Depreciation	93.75	108.71	104.97
All other	15.38	21.75	20.16
Total expense (dollars)	334.38	428.03	404.63

The largest items of expense were for gasoline, depreciation, and repairs. These automobiles were driven an average of 10,490 miles per year and averaged 13.8 miles per gallon of gasoline. Thirty-six per cent of this use was charged against the milk-retailing business.

Bad debts. The loss on bad debts amounted to $267 per distributor per year (table 33). With the average selling price of 10.78 cents per quart of milk equivalent, this amounted to a loss of 6¾ quarts a day out of total daily sales of 347 quarts.

The four items, labor, truck, automobile, and bad debts, made up 93 per cent of the cost of selling and delivering milk. Other items such as licenses and permits, state publicity tax, interest on slow accounts, advertising, ice, and the like, constituted less than 7 per cent of the selling and delivery costs.

Analysis of administrative costs

Items which did not fit into the three major classifications of plant, containers, and selling and delivery expense, were classified as administrative costs. Here again, labor was the most important item. About 400 hours, or a little more than an hour per day, was required in bookkeeping and general overseeing of the business. This amounted to $220 per distributor, or 0.17 of a cent per quart of milk equivalent sold (table 37). The average cost of administrative labor was 55 cents per hour.

TABLE 37. ADMINISTRATIVE COSTS FOR 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
	Amount per distributor		
	Dollars	*Dollars*	*Dollars*
Labor	125	297	220
Telephone	30	48	40
Office supplies	17	40	29
All other	*	29	17
Total	172	414	306
	Amount per quart		
	Cents	*Cents*	*Cents*
Labor	0.19	0.17	0.17
Telephone	0.05	0.03	0.03
Office supplies	0.03	0.02	0.02
All other	†	0.01	0.02
Total	0.27	0.23	0.24

*Less than 50 cents.
†Less than 0.005 cent.

This was somewhat higher than for plant or delivery labor because more of the work was performed by the operator and less by hired labor (table 38). The larger distributors hired bookkeepers to do the office work, but in the smaller businesses most of this work was done by the operator and his family.

Cost differences by areas

There was considerable variation in costs for producer-distributors situated in the several areas. Total costs per quart ranged from slightly more than 3 cents per quart for the Capital District, to slightly less than

TABLE 38. AMOUNT, COST, AND SOURCE OF OFFICE AND ADMINISTRATIVE LABOR, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
Total cost of labor (dollars)	125	297	220
Total hours of labor	234	534	400
Cost per hour of labor (cents)	53	56	55
Percentage of total hours of administrative labor by:			
Operator	62	48	51
Other family help	19	23	22
Hired persons	19	29	27
Total	100	100	100

TABLE 39. OPERATING COSTS PER QUART OF MILK EQUIVALENT, CLASSIFIED BY DEPARTMENTS, FOR 92 PRODUCER-DISTRIBUTORS IN FOUR MARKET AREAS, 1935–36

Item	Jamestown	Central New York	Capital District	Long Island	All areas
Number of distributors	27	28	15	22	92
Average daily volume (quarts)	368	366	461	221	347
	Amount per distributor				
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Plant	1,948	1,982	2,135	1,607	1,907
Containers	342	383	391	272	346
Selling and delivery	2,327	2,764	2,697	2,531	2,569
Administrative	159	468	227	334	306
Total	4,776	5,597	5,450	4,744	5,128
	Amount per quart				
	Cents	*Cents*	*Cents*	*Cents*	*Cents*
Plant	1.45	1.48	1.27	1.99	1.50
Containers	0.25	0.29	0.23	0.34	0.27
Selling and delivery	1.72	2.06	1.60	3.14	2.02
Administrative	0.12	0.35	0.13	0.41	0.24
Total	3.54	4.18	3.23	5.88	4.03

6 cents per quart for the Long Island distributors (table 39). In the Jamestown area, the total cost amounted to about 3.5 cents per quart, and in the central New York area, to 4.2 cents per quart.

The main reason for differences in unit costs was the variation in volume of business. The average daily volume varied from 221 quarts of milk equivalent per distributor on Long Island to a high of 461 quarts for the Capital District. It is significant that the extremes in volume show an inverse relationship to the extremes in costs per quart. The differences in volume can be accounted for partially by differences in the proportion of the distributors who were pasteurizing. About two-thirds of the upstate distributors were pasteurizing. The other important reason for higher costs on Long Island, as compared with upstate cities, was higher wages. Wage rates were 28 per cent higher on Long Island than in upstate cities.

Summary of costs per retail quart of milk

In the foregoing discussion, the cost of distributing a quart of milk was based on the milk equivalent of the milk, cream, and by-products sold. Such cost figures sometimes are interpreted as applying to the quart bottle of milk as delivered at the consumer's doorstep, but of course this is not correct. In this section of the report, an attempt is made to allocate the total costs of operation to the several products and services, so as to segregate the costs for milk delivered to retail customers.[10]

Cost of distributing a retail quart of pasteurized or raw milk. The total cost of processing and distributing a quart bottle of retail milk at the time of this study amounted to 5.14 cents (table 40). The total cost per quart for the distributors selling pasteurized milk was somewhat higher than that for the distributors selling raw milk. This is the reverse of the relationship that was found when costs were computed on the basis of milk equivalent. A much larger proportion of the total volume of business of the pasteurizing distributors was in the form of cream and also a larger percentage of the total volume was sold at wholesale. The conversion of these items into units of retail milk equivalent tended to reduce the relative volume of business of the pasteurizing distributors and to increase the relative cost per quart.

TABLE 40. COSTS OF DISTRIBUTING A QUART BOTTLE OF RETAIL MILK, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	41 distributors of raw milk	51 distributors of pasteurized milk	All distributors
	Amount per quart		
	Cents	*Cents*	*Cents*
Plant	1.61	1.74	1.71
Container	0.33	0.30	0.31
Selling and delivery	2.66	2.88	2.82
Administrative	0.30	0.31	0.30
Total costs	4.90	5.23	5.14

The total cost of distributing a quart bottle of retail milk varied from 6.53 cents for the Long Island area, to 4.42 cents for the Capital District

TABLE 41. VARIATION BETWEEN AREAS IN THE COSTS OF DISTRIBUTING A QUART BOTTLE OF RETAIL MILK, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	Jamestown	Central New York	Capital District	Long Island
	Amount per quart			
	Cents	*Cents*	*Cents*	*Cents*
Plant	1.72	1.67	1.41	2.16
Container	0.29	0.32	0.26	0.37
Selling and delivery	2.59	2.75	2.57	3.54
Administrative	0.16	0.43	0.18	0.46
Total	4.76	5.17	4.42	6.53

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[10] The method of allocating the total costs to the several products and services is explained in the Appendix, pages 80–82.

(table 41). The rank of the several areas in cost of distribution of a quart of retail milk was the same as that for a quart of fluid-milk equivalent.

PRINCIPAL FACTORS AFFECTING COSTS AND PROFITS

One-fifth of the producer-distributors included in this study had a net operating cost of 6 cents or more per quart, and about one-seventh had a cost of less than 3 cents per quart. This wide range in the cost of distributing milk is one of the principal causes of variation in profits. One distributor made a profit of $11,446. One sustained a loss of $2717. About one-fourth of the distributors failed to show a return above their operating costs; about one-third made a profit of $1000 or less; and about one in seven made a profit of $3000 or more above all costs, including a charge for unpaid labor and interest on the investment.

Volume of business

In general, the distributors who handled the larger quantities of milk had lower costs per quart for all operations. They handled more quarts of milk per hour of labor and per man, more quarts per truck and per mile of route, and more quarts per $100 of capital. The volume of milk handled was apparently the most important factor affecting the success of both the distributors of raw milk and the distributors of pasteurized milk.

Relation of volume of business to prices, costs, and profits. The average net operating cost for the 14 raw-milk distributors selling 204 or more quarts of milk per day was 4.0 cents a quart, as compared with 5.2 cents for the distributors who sold less than 117 quarts of milk per day (table 42). A similar relationship of volume to costs was found for the dis-

TABLE 42. RELATION OF VOLUME OF BUSINESS TO PRICES, COSTS, AND PROFITS, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	41 distributors of raw milk with daily sales of—			51 distributors of pasteurized milk with daily sales of—		
	Less than 117 quarts	117 to 203 quarts	204 quarts or more	Less than 293 quarts	293 to 402 quarts	403 quarts or more
Number of distributors	14	13	14	17	17	17
Average daily volume (quarts milk equivalent)	66	159	306	177	344	931
	Amount per distributor					
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Sales	2,879	7,346	14,093	6,759	13,853	33,918
Product cost	1,443	3,900	7,114	3,425	7,147	18,482
Gross spread	1,436	3,446	6,979	3,334	6,706	15,436
Net operating cost	1,264	2,738	4,486	3,088	5,688	11,736
Net profit	172	708	2,493	246	1,018	3,700
	Amount per quart					
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
Sales	11.9	12.6	12.6	10.4	11.0	9.9
Product cost	6.0	6.7	6.4	5.3	5.7	5.4
Gross spread	5.9	5.9	6.2	5.1	5.3	4.5
Net operating cost	5.2	4.7	4.0	4.7	4.5	3.4
Net profit	0.7	1.2	2.2	0.4	0.8	1.1

tributors of pasteurized milk. Those with larger volume had larger profits. This was due in part to a larger profit per quart of milk, and partly to the greater number of quarts handled.

The total profit per distributor in the group of 17 pasteurizing distributors selling less than 293 quarts per day was $246, as compared with $3700 for those handling 403 or more quarts per day. Although the smaller distributors generally made less profit, their selling prices were higher and their gross spread was greater.

Relation of volume to the various costs of distribution. Differences in the volume of milk handled have more effect upon unit costs in the plant than upon unit costs for selling and delivery. An increase of about five times in the total volume of business was accompanied by a reduction of 0.9 of a cent in the plant costs per quart for the raw-milk distributors and slightly over 0.8 of a cent for the pasteurizing distributors (table 43).

TABLE 43. RELATION OF VOLUME OF BUSINESS TO THE COSTS OF DISTRIBUTING MILK, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	41 distributors of raw milk with daily sales of–				51 distributors of pasteurized milk with daily sales of–			
	Less than 117 quarts	117 to 203 quarts	204 quarts or more	Average quarts	Less than 293 quarts	293 to 402 quarts	403 quarts or more	Average quarts
Number of distributors	14	13	14	41	17	17	17	51
Average quarts of milk equivalent sold daily	66	159	306	177	177	344	931	484
	Operating cost per quart							
Cost classification:	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
Plant	2.18	1.58	1.29	1.48	2.15	1.68	1.32	1.51
Container	0.32	0.31	0.30	0.30	0.27	0.27	0.26	0.26
Selling and delivery	2.56	2.57	2.12	2.31	2.32	2.36	1.71	1.94
Administrative	0.18	0.26	0.29	0.27	0.17	0.21	0.25	0.23
Total	5.24	4.72	4.00	4.36	4.91	4.52	3.54	3.94

The same increase in volume decreased the selling and delivery costs not quite 0.5 of a cent a quart for the distributors selling raw milk, and 0.6 of a cent for the distributors of pasteurized milk. There was no significant change in the unit costs for containers and administration, with a change in volume of business.

The total cost of distributing milk by the pasteurizing distributors showed a steady decrease with an increase in the volume of milk handled (figure 16). The rate of decrease in costs was somewhat more rapid among the small distributors than among those with more than average volume. However, some distributors with less than average volume had relatively low costs per quart of milk handled. These distributors obtained low costs in one or a combination of the following ways: (1) doing custom work for other milk dealers, such as pasteurizing, bottling, and bottle washing; (2) using unpaid family labor or other cheap help; (3) using secondhand equipment and inexpensive buildings; or (4) using ice instead of mechanical refrigeration. Usually the ice was put up by the regular farm help during spare time. Such economies may have affected the quality of the product adversely, but they were effective in keeping costs down.

The relationship of volume to distribution costs for the raw-milk distributors was similar to that of the pasteurizing distributors (figure 17). With few exceptions, those distributors who handled less than 150 quarts per day had high costs. Some of the producers who retailed small quantities of raw milk also delivered milk to a country milk plant. Since the retail delivery added but little driving to the daily trip to the milk plant, it was possible to obtain relatively low costs. Other raw-milk distributors had a small investment and used unpaid labor for a large part of their operations. Since they had a small route and were personally acquainted with their customers, they lost few bottles; likewise bad-debt losses were small. Consequently these distributors were able to sell milk at a lower cost. Their profits were further increased because they were able to sell practically all of their supply at retail prices.

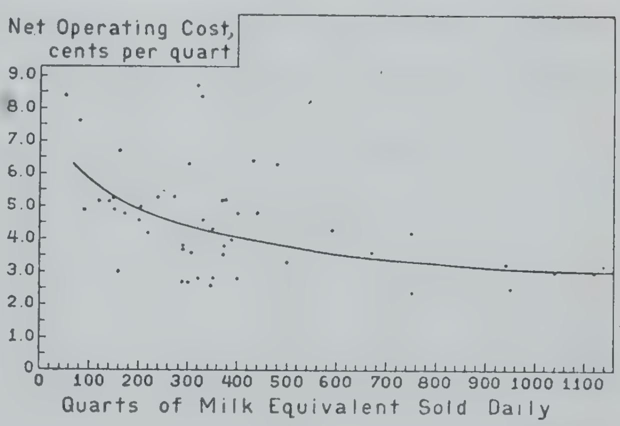

FIGURE 16. RELATION OF THE VOLUME OF MILK SOLD PER DISTRIBUTOR DAILY TO NET OPERATING COST PER QUART, 49 PRODUCER-DISTRIBUTORS OF PASTEURIZED MILK, NEW YORK STATE, 1935–36
(Free-hand curves checked by group averages)

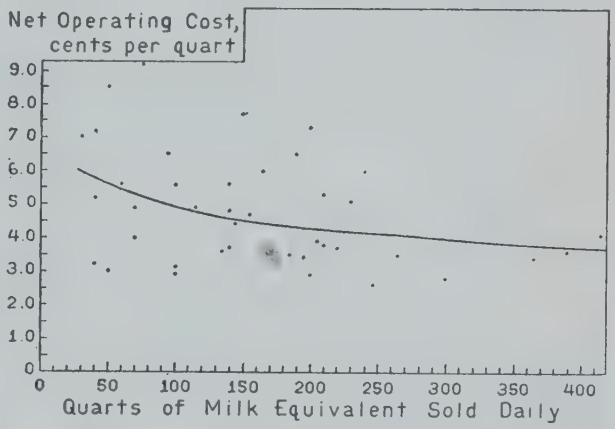

FIGURE 17. RELATION OF THE VOLUME OF MILK SOLD PER DISTRIBUTOR DAILY TO NET OPERATING COST PER QUART, 40 PRODUCER-DISTRIBUTORS OF RAW MILK, NEW YORK STATE, 1935–36
(Free-hand curves checked by group averages)

The additional cost of pasteurizing milk in no way affects the costs other than plant costs. The average plant costs for all distributors of raw milk and all pasteurizing distributors were the same. For the distributors with like volume, however, there was a somewhat higher cost for those selling pasteurized milk. The average volume for the 41 distributors of raw milk was 177 quarts daily. This was the same as the average volume of the 17 smallest distributors of pasteurized milk. The plant costs of the former group were about 1.5 cents per quart, as compared with nearly 2.2 cents for the latter group. The difference, amounting to 0.7 of a cent, may be taken as the added cost of operating a pasteurizing plant. The cost of maintaining pasteurizing equipment and the other additional costs for labor, fuel, and the like, amounted to from one-half to three-fourths of a cent per quart when there was no difference in volume. Apparently an increase of about two and one-half times in volume will offset the extra cost of pasteurizing if none of the efficiency is lost in the delivery end of the business. If all the milk can be carried on one truck, even though it might be necessary to make two trips, greater route efficiency will be obtained. But if it is necessary to add another truck, a decrease in delivery efficiency is likely to result unless there is enough volume to make two large loads of milk.

Relation of volume to labor efficiency. As previously shown, labor charges constitute nearly half the total cost of distributing milk. With an average of nearly 20 quarts of milk sold per hour of labor and with labor at 40 cents per hour, the labor cost is roughly two cents per quart.

In this study, the distributors handling the larger quantities of milk had higher labor efficiency for two reasons. In the first place, they were using more labor-saving equipment; secondly, more quarts of milk were handled per hour of labor because some of the jobs required a certain amount of time regardless of the volume. For example, the cleaning of equipment and floors requires practically the same amount of time whether the daily volume is 100 or 500 quarts. Likewise, the time required to drive from the plant to the first customer and return is the same whether 100 or 350 quarts are carried on the truck. The volume of milk handled per hour in all operations was nearly doubled with an increase of about five times in the volume of milk handled (table 44). This relationship was practically the same for both types of distributors. An increase in total volume had more effect on labor efficiency in the plant than it did in the delivery end of the business. With an increase of about five times in volume, there was an increase of more than 100 per cent in the amount of milk handled in the plant per hour of plant labor, whereas only about 50 per cent more milk was delivered per hour of delivery work. The most striking increase in labor efficiency, with an increase in the volume handled, occurred in the businesses with less than 500 quarts of daily sales. Beyond 500 quarts there was some increase in labor efficiency, but it was at a slower rate (figure 18).

TABLE 44. RELATION OF VOLUME OF BUSINESS TO LABOR EFFICIENCY AND COST PER HOUR OF LABOR, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	41 distributors of raw milk with daily sales of–				51 distributors of pasteurized milk with daily sales of–			
	Less than 117 quarts	117 to 203 quarts	204 quarts or more	Average quarts	Less than 293 quarts	293 to 402 quarts	403 quarts or more	Average quarts
Number of distributors	14	13	14	41	17	17	17	51
Average quarts of milk equivalent sold daily	66	159	306	177	177	344	931	484
Cost per hour of labor (cents)	30	36	42	38	31	37	41	38
Quarts of milk sold per hour of all labor	11	16	20	17	14	19	26	22
Quarts of milk processed per hour of plant labor	22	38	55	42	31	50	65	54
Quarts of milk sold per hour of delivery labor	23	28	36	32	27	32	40	41

The greater efficiency of labor employed by the larger distributors was offset in part by higher wage rates. The labor cost amounted to about 40 cents per hour for the high-volume group, as compared with about 30 cents per hour for the low-volume group.

Relation of volume to route efficiency. Volume is related to route efficiency only as it makes possible the delivery of a larger load of milk per truck. In general, the distributors with larger volume had larger loads, but the size of load did not increase in proportion to the total volume. The delivery of a larger load of milk per truck usually results in lower delivery costs per quart of milk. The group of raw-milk distributors with the smallest volume sold only 66 quarts of milk per day, operated one delivery truck, and traveled 12 miles per day for deliveries (table 45). The delivery cost for this group amounted to around 2.0 cents per quart. This cost was relatively low because, as explained earlier, some of these distributors combined retail delivery with the delivery of milk to a dealer's plant. In these instances, not all of the driving was charged against the milk route. Many small distributors were using inexpensive delivery trucks or automobiles and cheap labor. The group of raw-milk distributors with the largest volume sold an average of 306 quarts of milk a day and delivered 248 quarts per truck, with 43 miles of driving. The delivery cost for this group was 1.9 cents per quart.

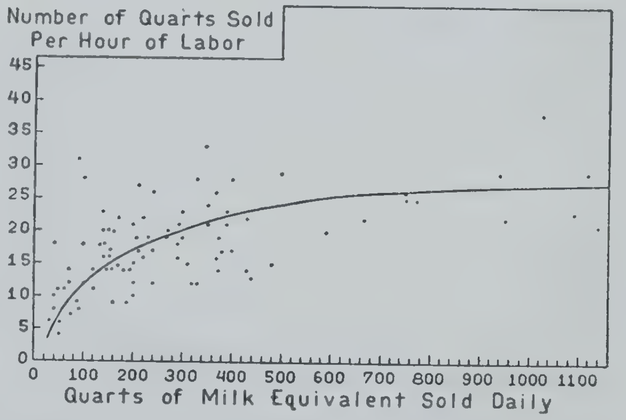

FIGURE 18. RELATION OF THE VOLUME OF MILK SOLD PER DISTRIBUTOR DAILY TO LABOR EFFICIENCY, 90 PRODUCER-DISTRIBUTORS, 1935–36

(Free-hand curves checked by group averages)

TABLE 45. RELATION OF VOLUME OF BUSINESS TO ROUTE EFFICIENCY, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	41 distributors of raw milk with daily sales of–				51 distributors of pasteurized milk with daily sales of–			
	Less than 117 quarts	117 to 203 quarts	204 quarts or more	Average quarts	Less than 293 quarts	293 to 402 quarts	403 quarts or more	Average quarts
Number of distributors	14	13	14	41	17	17	17	51
Average quarts of milk equivalent sold daily	66	159	306	177	177	344	931	484
Quarts sold per delivery truck	63	141	248	157	170	246	370	286
Miles driven per truck daily	12	30	43	29	32	37	44	39
Quarts sold per mile of route	5.3	4.8	5.7	5.4	5.3	6.7	8.5	7.4
Quarts sold per customer daily	1.2	1.1	1.5	1.4	1.6	1.7	1.7	1.7
Number of customers per mile of route	4.3	4.3	3.8	4.0	3.3	3.9	4.9	4.3
Delivery cost per quart (cents)	2.0	2.1	1.9	2.0	1.9	2.0	1.4	1.6

The distributors of pasteurized milk with the smallest volume had an average load of 170 quarts, compared with a load of 370 quarts per day for the group with the largest volume. The distributors with larger loads had longer routes, but usually more customers per mile of route and more quarts of milk sold per mile of route. The cost of delivery was about one-half cent lower for the distributors with the larger loads.

Relation of volume to capital efficiency. A larger volume of milk makes possible greater efficiency in the use of machinery, buildings, trucks, and other capital items. The capital invested per quart of daily sales was $12 and $18 respectively for the low-volume groups of raw-milk and pasteurizing distributors, compared with $8 and $11 for the high-volume groups (table 46).

TABLE 46. RELATION OF VOLUME OF BUSINESS TO EFFICIENCY IN THE USE OF CAPITAL, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	41 distributors of raw milk with daily sales of–				51 distributors of pasteurized milk with daily sales of–			
	Less than 117 quarts	117 to 203 quarts	204 quarts or more	Average quarts	Less than 293 quarts	293 to 402 quarts	403 quarts or more	Average quarts
Number of distributors	14	13	14	41	17	17	17	51
Average quarts of milk equivalent sold daily	66	159	306	177	177	344	931	484
Total capital invested per distributor (dollars)	764	1,992	2,514	1,751	3,106	4,629	9,918	5,884
Total sales per distributor (dollars)	2,879	7,346	14,093	8,128	6,759	13,853	33,918	18,178
Number of months for sales to equal capital	3.2	3.3	2.1	2.6	5.5	4.0	3.5	3.9
Capital per quart of daily sales (dollars)	12	13	8	10	18	13	11	12
Interest charge:								
Per distributor (dollars)	38	100	126	88	155	231	496	294
Per quart (cents)	0.16	0.17	0.11	0.14	0.24	0.18	0.15	0.17

The capital turnover shows a similar relationship to volume. The interest charge per quart of milk shows a reduction of 0.05 cent per quart between the low- and high-volume groups of the raw-milk distributors, and 0.09 cent per quart between the low- and high-volume groups of the distributors selling pasteurized milk.

Relation of volume to type of business. The larger distributors in both the raw-milk and pasteurized-milk groups were selling a larger proportion of cream and by-products than were the smaller distributors (table 47). Likewise, they were selling a smaller percentage of milk and other products at retail prices. In general, the raw-milk distributors made a larger percentage of their sales as fluid milk at retail prices than was

TABLE 47. RELATION OF VOLUME OF BUSINESS TO TYPE OF SALE AND OTHER FACTORS, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	41 distributors of raw milk with daily sales of–				51 distributors of pasteurized milk with daily sales of–			
	Less than 117 quarts	117 to 203 quarts	204 quarts or more	Average quarts	Less than 293 quarts	293 to 402 quarts	403 quarts or more	Average quarts
Number of distributors	14	13	14	41	17	17	17	51
Average quarts of milk equivalent sold daily	66	159	306	177	177	344	931	484
Value of daily sales (dollars)	8	20	38	22	18	38	93	50
Percentage of milk equivalent sold as milk	95	87	84	86	83	80	76	78
Percentage of milk equivalent sold at retail	88	89	85	87	67	67	53	58

true for those selling pasteurized milk. This fact enables the many raw-milk distributors to continue in business in spite of their smaller volume and high cost per quart.

The fact that the larger distributors were disposing of a smaller proportion of their milk supply to retail customers explains in part the lower average prices they received, as well as their lower costs per quart and greater volume handled per hour of labor.

Labor efficiency

Producer-distributors with a large volume of business usually have full-time employees in the plant and on the route. But on the farms of many of the distributors with a small volume of business, much of the work of processing and delivering milk is performed by the regular farm help. Because of this farm-to-farm variation in the number of part-time employees in the milk-distribution enterprise, it is difficult to measure, on a comparable basis, the amount of milk sold per man. Therefore, for the purpose of this report, labor efficiency is expressed in terms of milk sold per hour of labor.

Of the distributors interviewed in this study, the amount of milk handled per hour of labor varied from 4 to 52 quarts. Six distributors handled less than 9 quarts per hour, and five handled 30 or more quarts per hour of labor. The volume of milk handled was one of the most important factors affecting labor efficiency. However, when the data were analyzed in detail it was found that not all the distributors with a large volume of business were efficient in the use of labor.

Relation of labor efficiency to costs, profits, and other factors. When the volume of milk handled per hour of labor was plotted against the cost per quart, there was a consistent decrease in the costs with an increase in labor efficiency (figure 19). This decrease in costs was more rapid up to 20 quarts per hour of labor than beyond that point. Further increase in labor efficiency will reduce costs, but at a slower rate. The relatively small amount of scatter of the individual observations about the curve of general relationship indicates a high degree of correlation between labor efficiency and costs per quart of milk handled.

In order to study the effect of labor efficiency separately from the volume of business, the distributors were classified into three groups based on the volume handled, with sub-groupings according to the amount of milk sold per hour of labor (table 48). While the effects of volume differences are not entirely eliminated in this way, the results indicate firstly, that marked differences in labor efficiency exist among businesses of similar volume; secondly, that greater labor efficiency generally means lower costs and larger profits, without respect to

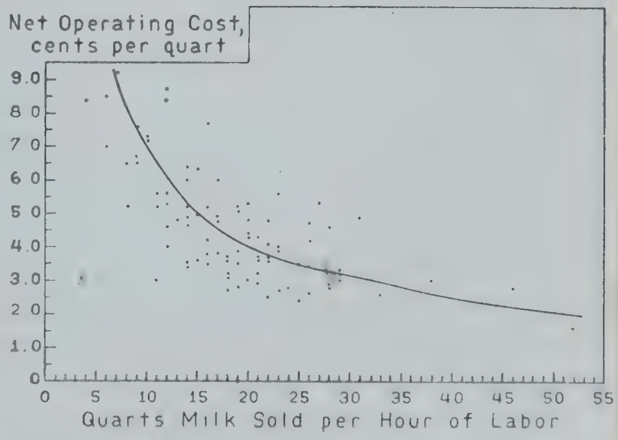

Figure 19. relation of labor efficiency to net operating cost per quart, 92 producer-distributors, 1935–36
(Free-hand curves checked by group averages)

volume of business; and thirdly, that large volume is of little advantage unless it brings with it efficiency in the use of labor. It is apparent that labor efficiency can be improved, not only by increasing the volume of milk handled, but also by other means, as by the use of more labor-saving machinery in the plant and better organization of delivery routes.

In each of the volume groups the distributors with high labor efficiency sold more milk per truck and per mile of route, and made larger sales per customer per day than did the distributors with low labor efficiency (table 48). In addition, members of the former group generally had more capital invested in plant equipment. This further indicates that in order to be efficient in the use of labor, it is advisable to give careful attention to the organization of the delivery route or routes, and to use labor-saving machines in the plant. The use of labor-saving machinery usually, but not necessarily, increases the efficiency of the plant labor force. One of the larger distributors included in this study stated that he would not consider the use of new labor-saving machinery unless the plant work could be performed with one less man than formerly. If he installed the new equipment and still had to hire the same number of men, he would be making less money than before adding the labor-saving devices.

TABLE 48. RELATION OF LABOR EFFICIENCY AND VOLUME OF BUSINESS TO PRICES, COSTS, PROFITS, AND OTHER FACTORS, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	Sales-volume group					
	Less than 165 quarts		166 to 328 quarts		329 quarts or more	
	Quarts of milk sold per hour of labor		Quarts of milk sold per hour of labor		Quarts of milk sold per hour of labor	
	Less than 14	14 or more	Less than 18	18 or more	Less than 23	23 or more
Number of distributors	15	16	15	15	15	16
Amount per quart of milk equivalent (cents):						
Selling price	12.1	11.7	12.0	11.1	11.3	9.8
Gross spread	6.2	5.6	5.9	5.2	5.4	4.5
Net operating cost	6.3	4.6	5.5	3.8	4.1	3.2
Net profit	−0.1	1.0	0.4	1.4	1.3	1.3
Plant cost	2.8	1.7	1.9	1.4	1.6	1.2
Selling and delivery cost	3.0	2.4	3.0	2.0	2.2	1.6
Quarts of milk equivalent:						
Sold daily	73	129	234	255	518	855
Sold per hour of all labor	9	18	13	22	18	30
Processed per hour of plant labor	17	40	36	51	47	75
Sold per hour of delivery labor	19	34	22	40	31	47
Sold per delivery truck, daily	71	124	175	248	274	392
Sold per mile of route, daily	4.0	5.1	4.8	6.4	6.3	9.7
Sold per customer, daily	1.2	1.3	1.3	1.9	1.3	2.1
Labor cost per hour (cents)	29	39	35	38	36	43

Among the distributors studied, the increase in labor efficiency was partly offset by higher wage rates. The distributors with high labor efficiency paid an average of from 3 to 10 cents more per hour of labor than did those with lower labor efficiency. Nevertheless the distributors with high labor efficiency had substantially lower costs per quart for both plant operation and delivery.

The sub-group of distributors with greater labor efficiency were conducting a somewhat different type of business from that of the others. Retail sales constituted a smaller proportion of their business, as indicated by the lower average price received. This resulted in somewhat smaller labor requirements, particularly in the delivery end of the business. Thus the savings in operating expense to those distributors who had a high degree of labor efficiency were offset in part by a smaller spread between selling price and product cost.

This interrelationship between the quantity of milk handled and the type of business done also needs to be considered in connection with figure 18.

Route efficiency

The ideal situation for route operation is to be able to deliver a large load of milk within a small area. In other words, both the size of loads and the compactness of routes are important.

Size of loads. Ordinarily the operation of a milk route calls for the full-time service of a man and a vehicle, usually a motor truck. If only a small quantity of milk is delivered on the route, the cost per quart for labor and truck will be high. If the load is increased, the delivery expense will not rise proportionately, and the cost per quart will be reduced.

The advantage of larger-than-average loads is not as great in the case of producer-distributors as it is to other milk dealers. Since most producer-distributors of milk are in a position to use the part-time service of men and trucks on their routes, they are less handicapped than other milk dealers by small loads. Not infrequently the person who makes the deliveries also works a part of the day in the plant or on the farm. Likewise, the truck that is used on the route may be used for other purposes after the milk deliveries have been completed.

Nevertheless, good-sized loads on the milk routes are an advantage to the producer-distributors. This is shown in table 49, where 73 of the producer-distributors included in this study have been grouped by their total volume of business and sub-grouped by the quantity of milk delivered per truck daily.

In each volume group the selling and delivery cost per quart was lower when the size of loads was larger than average. However, the savings in delivery costs resulting from larger loads are much greater among the distributors whose total volume was 269 quarts or more per day. In that group, the distributors whose route loads were 300 quarts or more saved 0.9 cent a quart on selling and delivery costs, including 0.3 cent reduction in truck expense and 0.5 cent on labor. The number of quarts handled per hour of delivery labor was one-third greater for the distributors with large loads than for those with smaller loads.

The distributors with small volume and small loads kept their costs within reasonable limits by using unpaid family labor or other cheap labor, and cheap trucks or automobiles, by carrying no insurance on the truck, and by using the truck for as much other farm work as possible.

When the change was made from selling raw milk to selling pasteurized milk, and the volume of business enlarged, many distributors were faced

TABLE 49. RELATION OF SIZE OF LOAD TO DELIVERY COSTS AND OTHER FACTORS, 73 PRODUCER-DISTRIBUTORS, 1935–36*

Item	Sales-volume group (quarts daily)					
	Less than 150		150 to 268		269 and over	
	Quarts daily per truck					
	Less than 100	100 and over	Less than 190	190 and over	Less than 300	300 and over
Number of distributors	13	12	12	12	11	13
Total quarts daily	58	129	184	227	453	514
Quarts daily per truck	58	129	157	227	217	371
Per cent sold retail	84	88	82	81	84	77
Amount per quart (cents):						
Gross spread	5.6	6.2	5.6	5.9	5.8	5.7
Net operating cost	6.4	4.8	5.0	4.4	5.1	3.6
Net profit	–0.8	1.4	0.6	1.5	0.7	2.1
Selling and delivery cost	2.9	2.5	2.8	2.4	2.8	1.9
Truck cost	0.8	0.8	0.9	0.7	0.9	0.6
Cost delivery labor	1.4	1.1	1.3	1.3	1.4	0.9
Quarts per hour of delivery labor	20	34	28	28	30	41
Miles per truck, daily	4.5	8.7	13.1	15.7	15.5	14.1
Truck cost per mile (cents)	3.6	4.1	3.8	3.5	4.5	6.0

*Does not include those selling less than 60 per cent of total milk equivalent to retail customers.

with the problem of getting an economical use of delivery trucks. Sometimes the volume was too great for one truck, yet too small to make good loads for two trucks. Many distributors have solved this problem by making two trips per day with one truck. The family trade is served on the first trip, and the wholesale customers on the second trip. This has eliminated the necessity for keeping an extra truck and an extra man, and has helped to reduce delivery costs below what they were prior to pasteurizing. In this report the size of load is considered as all the milk delivered per truck per day, regardless of the number of trips.

In each volume group represented in table 49 the net operating costs per quart were considerably less and the profit considerably higher for those distributors who had large loads on their routes. However, these gains must be credited in part to differences in volume, labor efficiency, and other factors with which the size of load is correlated.

Compactness of route. A good deal of variation was found among the producer-distributors in respect to the quantities of milk sold per mile of route. In general, the distributors of like quantities of milk, who had the more compact routes, had lower costs and larger profits (table 50).

The greatest savings per quart from larger-than-average sales per mile of route accrued to the distributors handling less than 150 quarts a day. In that group, those delivering 5 quarts or more per mile saved 1.3 cents a quart on selling and delivery costs, as compared with more scattered routes. The distributors with the more compact routes had 0.4 cent less spread per quart, but the net operating cost was reduced 1.7 cents and the profit raised from zero to 1.3 cents a quart. Nearly as much advantage from larger-than-average sales per mile are shown for the middle-sized and the large distributors.

According to this tabulation, large sales per mile of route were ac-

TABLE 50. RELATION OF QUARTS OF MILK SOLD PER TRUCK-MILE TO DELIVERY COSTS AND OTHER FACTORS, 73 PRODUCER-DISTRIBUTORS, 1935–36*

Item	Sales-volume group (quarts daily)					
	Less than 150		150 to 268		269 and over	
	Quarts per mile					
	Less than 5	5 or more	Less than 5	5 or more	Less than 8	8 or more
Number of distributors	12	13	11	13	13	11
Quarts daily per distributor	85	98	192	216	482	491
Quarts daily per truck	85	98	162	216	371	338
Miles per truck daily	22.4	13.5	52.3	26.1	48.7	41.3
Quarts sold per mile	3.8	7.3	3.1	8.3	5.1	11.9
Per cent sold retail	88	86	87	77	80	80
Amount per quart (cents):						
Gross spread	6.2	5.8	6.0	5.5	5.7	5.8
Net operating cost	6.2	4.5	5.3	4.1	4.7	3.7
Net profit	0.0	1.3	0.7	1.4	1.0	2.1
Total selling and delivery cost	3.3	2.0	3.1	2.1	2.6	1.9
Truck cost	1.0	0.6	1.1	0.5	0.9	0.5
Cost delivery labor	1.5	1.0	1.6	1.1	1.3	1.0
Quarts per hour of delivery labor	21	36	24	33	34	37
Truck cost per mile (cents)	3.8	4.2	3.3	4.4	4.6	6.4
Labor cost per hour (cents)	32	38	38	36	44	36
Number of customers per mile of route	8.4	15.3	7.3	13.3	10.4	20.8
Quarts per customer, daily	1.2	1.3	1.2	1.7	1.4	1.6

*Does not include those selling less than 60 per cent of total milk equivalent to retail customers.

complished principally by having more customers per mile. However, the quantities sold per customer were somewhat larger on the more compact routes. It will be noted, also, that the distributors with the larger sales per mile had considerably shorter routes. Among the middle-sized businesses, those with the larger sales per mile had much the larger loads, but this was not true for either the small or the large businesses.

Apparently compact routes are more important to the success of producer-distributors than are large loads.

The distributors who were visited in this study reported various ways of reducing the amount of driving per customer. Two distributors in the same city had arranged to deliver milk to each other's customers. Each made deliveries in half of the city. The result was a shorter, more compact route for each. Prior to this arrangement, they were traveling 40 miles per day. Through the cooperative arrangement they were able to make a substantial reduction in the amount of driving. Another method was to avoid serving customers in out-of-the-way places, or if they were taken on, delivery was made on alternate days. Distributors who operated more than one route in a city found that it was necessary to shift customers from one route to another in order to keep the routes well arranged.

Capital efficiency

Efficiency in the use of capital is less important in its effect on costs than the other factors previously discussed. Efficiency in the use of capital reduces costs principally through reducing the interest charge. In addition to the higher interest charge on the money invested, the distributors with a large amount of capital take greater risks and have more expense because of depreciation of capital items, such as buildings, machinery, and accounts receivable.

Relation of capital turnover to costs and profits. It took 2.6 months for the sales of the raw-milk distributors included in this study to equal the amount of capital invested in the business. Pasteurizing distributors turned over their capital only once in 3.9 months. The pasteurizing distributors had more capital invested in relation to the daily sales or to the total volume of business than did the raw-milk distributors. In general, the raw-milk distributors employ less capital and more labor in relation to the volume of milk handled than do the distributors who operate pasteurizing plants. For this reason, efficiency in the use of capital would be less important for the distributors of raw milk than for those of pasteurized milk.

When the distributors of raw milk were segregated into three groups, based on the capital turnover, there was no significant relationship to operating costs (table 51). But, when the distributors of pasteurized milk were classified similarly, there was a difference in the operating costs of 1.4 cents a quart between the high and low groups. Not all of this difference was due to the amount of capital invested. The group of pasteurizing distributors most efficient in the use of capital also had the largest volume. The other savings that accrue from handling a larger volume of milk also are reflected in this reduced cost per quart.

TABLE 51. RELATION OF CAPITAL TURNOVER TO SALES, COSTS, AND PROFITS, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	Number of months for sales to equal capital					
	41 distributors of raw milk			51 distributors of pasteurized milk		
	Less than 2.0	2.0 to 2.9	3.0 and over	Less than 3.0	3.0 to 3.9	4.0 and over
Number of distributors	14	13	14	17	17	17
Average number of months for sales to equal capital	1.4	2.4	4.1	2.5	3.7	6.0
	Amount per distributor					
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Sales	8,507	8,423	7,464	21,194	17,671	15,665
Product cost	4,500	4,292	3,693	11,965	9,247	7,841
Gross spread	4,007	4,131	3,771	9,229	8,424	7,824
Net operating cost	3,335	2,697	2,437	7,446	6,015	7,018
Net profit	672	1,434	1,334	1,783	2,409	806
	Amount per quart					
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
Sales	13.3	12.3	11.9	9.8	10.5	10.6
Product cost	7.0	6.3	5.9	5.5	5.5	5.3
Gross spread	6.3	6.0	6.0	4.3	5.0	5.3
Net operating cost	5.2	3.9	3.9	3.4	3.6	4.8
Net profit	1.1	2.1	2.1	0.9	1.4	0.5

The distributors with the most rapid turnover of capital had somewhat larger sales, but less total capital than had those with slower turnover. This resulted in a wide spread between the groups in the amount of capital invested per quart (table 52).

TABLE 52. RELATION OF CAPITAL TURNOVER TO OTHER FACTORS, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	Months for sales to equal capital					
	41 distributors of raw milk			51 distributors of pasteurized milk		
	Less than 2.0	2.0 to 2.9	3.0 and over	Less than 3.0	3.0 to 3.9	4.0 and over
Number of distributors	14	13	14	17	17	17
Average months for sales to equal capital	1.4	2.4	4.1	2.5	3.7	6.0
Capital per quart of daily sales (dollars)	5.55	9.13	15.04	7.35	11.96	19.45
Quarts milk equivalent sold daily	175	187	171	590	460	402
Value of daily sales (dollars)	23	23	20	58	48	43
Total capital (dollars)	971	1,708	2,571	4,335	5,500	7,818
Interest charge:						
Per year (dollars)	49	85	129	217	275	391
Per quart (cents)	0.08	0.12	0.21	0.10	0.16	0.27

Type of business

Regardless of the efficiency of the business, the cost of distributing a quart of milk will vary because of a difference in products and methods of sale. Some of the distributors had a large proportion of their sales in cream and by-products, while others limited the business almost entirely to fluid milk. Likewise, some distributors made a large proportion of their sales to wholesale customers, while others dealt almost entirely with family trade.

Relation of the proportion of milk equivalent sold as fluid milk to prices, costs, and profits. In general, the costs for distributors whose sales consisted mostly of fluid milk were at a considerably higher rate per quart than for the distributors who had sold a larger percentage of cream and other products (table 53). The distributors with a larger proportion of cream and by-product sales also had a larger volume of business, and this fact is probably responsible for a part of the difference in cost. Again, the distributors who handled more cream and by-products made a larger proportion of their sales to wholesale customers. This was another reason for the lower cost (table 54).

The number of distributors from whom records were obtained was insufficient to permit subsorting to eliminate the effect of size of business and method of sale upon the cost per quart of milk. However, it is obvious that the cream from 100 quarts of milk can be distributed at less cost than can 100 quarts of fluid milk. The ratios referred to on page 80 indicate the difference in the relative cost of distributing milk and cream in the various-sized containers to both wholesale and retail customers.

Combined effect of five important factors on costs and profits

The five most important factors affecting the success of the producer-distributors interviewed were: (1) volume of business, (2) labor effi-

TABLE 53. RELATION OF THE PERCENTAGE OF TOTAL MILK EQUIVALENT SOLD AS MILK TO PRICES, COSTS, AND PROFITS, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	Percentage of total milk equivalent sold as milk					
	41 distributors of raw milk			51 distributors of pasteurized milk		
	Less than 89	89 to 96	97 or more	Less than 78	78 to 87	88 or more
Number of distributors	14	13	14	17	18	16
Average percentage of sales as milk	76	93	99	67	81	92
	Amount per distributor					
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Sales	11,629	7,500	5,200	18,312	23,250	12,325
Product cost	6,021	3,769	2,657	10,124	12,361	6,206
Gross spread	5,608	3,731	2,543	8,188	10,889	6,119
Net operating cost	3,660	2,509	2,289	6,285	8,364	5,670
Net profit	1,948	1,222	254	1,903	2,525	449
	Amount per quart					
	Cents	*Cents*	*Cents*	*Cents*	*Cents*	*Cents*
Sales	12.5	12.0	13.3	9.4	10.3	11.9
Product cost	6.5	6.0	6.8	5.2	5.5	6.0
Gross spread	6.0	6.0	6.5	4.2	4.8	5.9
Net operating cost	3.9	4.0	5.9	3.2	3.7	5.5
Net profit	2.1	2.0	0.6	1.0	1.1	0.4

TABLE 54. RELATION OF THE PERCENTAGE OF TOTAL MILK EQUIVALENT SOLD AS MILK, TO VARIOUS FACTORS, 92 PRODUCER-DISTRIBUTORS, 1935–36

Item	Per cent of total milk equivalent sold as milk							
	41 distributors of raw milk				51 distributors of pasteurized milk			
	Less than 89	89 to 96	97 or more	Average	Less than 78	78 to 87	88 or more	Average
Number of distributors	14	13	14	41	17	18	16	51
Per cent of milk equivalent sold as milk	76	93	99	86	67	81	92	78
Per cent of milk equivalent sold retail	83	90	91	87	48	58	78	58
Value of daily sales (dollars)	32	20	14	22	50	64	34	50
Quarts milk equivalent sold daily	254	171	107	177	532	617	282	484
Plant cost per quart (cents)	1.4	1.4	1.9	1.5	1.3	1.4	2.2	1.5
Delivery cost per quart (cents)	1.8	1.9	2.5	2.0	1.3	1.5	2.4	1.6

ciency, (3) size of load, (4) compactness of route, and (5) capital turnover. If a producer-distributor can manage to be above average in all five of these factors, and if anything like a normal price situation prevails, he will be assured of a profitable business. Of the 92 producer-distributors included in this study, 7 were above average in all five factors (table 55). These seven distributors had an average net operating cost

TABLE 55. COMBINED EFFECT OF FIVE IMPORTANT FACTORS ON THE COSTS AND PROFITS IN DISTRIBUTING MILK, 92 PRODUCER-DISTRIBUTORS, 1935–36*

Factors in which distributors were above average	Distributors	Net operating costs per quart of milk	Average net profit or loss
Number	*Numbers*	*Cents*	*Dollars*
None	13	6.2	–262
One	28	5.2	461
Two	18	4.4	1,006
Three	13	4.0	1,685
Four	13	3.7	3,792
Five	7	2.7	4,729

*The factors are: volume of business; labor efficiency; size of load; compactness of route; and capital turnover.

of 2.7 cents per quart of milk, and made a profit of $4729 per distributor for the year. Thirteen of the 92 distributors were below average in all five of the factors listed. These distributors had a distribution cost of 6.2 cents per quart, and suffered a net loss of $262.

In comparison with the distributors who were below average in all factors, those who were above average in all five factors sold seven times as much milk daily; nearly three times as much milk per hour of labor; four times as much milk per truck; more than three times as much milk per mile of route; and turned their capital over in one-third less time (table 56). The largest profit made by any distributor who was below average in all five factors was $600, and the smallest profit made by any distributor above average in all five factors was $700. The net operating cost of the former distributor was 6.5 cents, and of the latter, 3.0 cents. The $600 profit of the inefficient distributor was the result of a wide spread between the average selling price and the product cost, whereas in the latter instance the small profit was due to an unfavorable spread.

TABLE 56. AVERAGES FOR EACH OF THE FIVE MOST IMPORTANT FACTORS AFFECTING THE COSTS AND PROFITS IN DISTRIBUTING MILK, 92 PRODUCER-DISTRIBUTORS, 1935–36

Number of factors	Number of distributors above average	Averages for distributors in each group				
		Quarts daily sales per distributor	Quarts sold per hour of labor	Quarts sold daily per truck	Quarts sold per mile of route	Months sales equal to capital
None	13	144	11	117	4	7.5
One	28	169	14	141	5	3.5
Two	18	230	20	179	8	3.1
Three	13	439	22	274	9	3.1
Four	13	632	26	401	10	3.5
Five	7	1,037	31	470	14	2.6
All distributors	92	347	20	238	7	3.5

From the foregoing analysis, there may be derived approximate minimum standards of efficiency with respect to the five important factors that are shown to have the greatest effect upon costs and profits. Such standards, with certain differences as between raw-milk and pasteurizing distributors, are given in table 57.

Volume is an important factor affecting the success of producer-distributors, but in spite of this, two distributors who were included in this

TABLE 57. STANDARDS OF EFFICIENCY FOR PRODUCER-DISTRIBUTORS IN NEW YORK STATE*

Factor	Basis of measurement	Approximate minimum rate for efficient operation	
		Raw-milk distributors	Pasteurizing distributors
Volume of business	Quarts daily	200	400
Size of load	Quarts per truck, daily	200	200
Compactness of routes	Quarts sold per mile of route	9	9
Labor efficiency	Quarts per hour of labor	18	25
Capital efficiency	Months sales equal to capital	2	3

*Directions for calculating costs, and factors to be used by distributors in comparing the efficiency of their businesses with the standards set up in this report are available on request to the Department of Agricultural Economics and Farm Management, New York State College of Agriculture, Ithaca, New York.

TABLE 58. NUMBER OF PRODUCER-DISTRIBUTORS WHO WERE ABOVE AVERAGE IN EACH OF THE FACTORS LISTED, 1935–36

Number of factors	Number of distributors above average	Number of distributors in each group who were above average in—				
		Quarts daily sales per distributor	Quarts sold per hour of labor	Quarts sold daily per truck	Quarts sold per mile of route	Months sales equal to capital
None	13	..	..	..	..	..
One	28	2	1	2	7	16
Two	18	3	9	3	9	12
Three	13	6	10	10	6	7
Four	13	11	12	13	10	6
Five	7	7	7	7	7	7
All distributors	92	29	39	35	39	48

study and who were above average in volume were below average in all other factors (table 58). Three were above average in volume, yet below average in three other factors. Six were above average in volume and below average in two other factors. Eleven were above average in volume and below average in one other factor. Of all 92 producer-distributors, only seven were above average in volume as well as in the other four factors.

MISCELLANEOUS FACTORS AFFECTING COSTS AND PROFITS

Population of market

Volume of business has been shown to be one of the most important factors affecting the costs and profits of the producer-distributors interviewed. The question then arises, what are the natural limitations in getting a large volume of business? The size of the city or village in which the distributor is retailing sets rather definite limits as to the volume any one distributor can acquire. The principal market of thirty of the distributors included in this survey had less than 4000 population, and averaged approximately 1700 (table 59). The distributors in this group sold 146 quarts daily, whereas the 34 distributors selling in cities of 45,000 or more had an average volume of nearly 500 quarts per day. No distributor who had a market with less than 4000 population handled more than 437 quarts a day, and only 7 distributors in this group handled more than 200 quarts daily.

TABLE 59. RELATION OF POPULATION OF THE PRINCIPAL MARKET TO VOLUME OF BUSINESS, 92 PRODUCER-DISTRIBUTORS, 1935–36

Population of market		Number of distributors	Daily volume, quarts	
Range	Average		Range	Average
Less than 4,000.......	1,733	30	32 to 437	146
4,000 to 44,999*	10,964	28	69 to 2,205	395
45,000 or more	56,324	34	49 to 2,339	485

*There were no cities in this group of more than 25,000 population.

Distance from market and type of highway

One-fourth of the distributors included in this study had milk plants less than one mile from the city in which they were retailing, and only one-tenth were four miles or more from the market. The average distance from the milk plant to the village or city limits of all 92 distributors was 2.2 miles, and no distributor was more than 10 miles from the market. The type of road is of even more importance than the distance from market. Of the average distance to market, 1.9 miles were hard road; 0.2 mile, gravel road; and only 0.1 mile, dirt road. It is important in the winter to be on a road that is kept free from snow.

Plant layout and location

Plant layout is an important factor affecting the amount of labor required per quart of milk processed. It is desirable to have the plant located near or attached to the barn, in order to save labor and to avoid too much exposure to the weather while carrying the milk from the barn. Care should be exercised to arrange the plant so that a minimum of steps will be taken in loading and unloading milk cases on the truck; also in pasteurizing, cooling, and other work. Many of the distributors visited in this study had the garage for the delivery truck attached to the milk plant. This made it possible for the delivery man to be out of the weather when loading the milk and when unloading the empty bottles from the delivery truck. The cold room should be so placed as to be accessible for loading the milk on the delivery truck. Some distributors had two doors to the cold room, one opening in the plant and the other opening into the garage. This arrangement eliminated many steps in loading the delivery truck.

Other things to consider in plant layout are: location of the bottle-washing room near the place where bottles are unloaded, location of the cooler for the raw milk near the door leading to the barn, and location of the bottler near the cold room so the full cases of milk can be placed immediately in the refrigerator. Floors that drain well save time as well as the patience of the plant man.

Record-keeping

Before a producer-distributor can locate the weaknesses in his business, he must have adequate records. This is especially important when the business gets beyond the family size. It is more important to keep records on the retail milk business than on the farm business. The milk business has many small cash transactions with numerous customers, and the cash turnover is more rapid than that of a farm business. Any cash leaks may quickly put the business in the red. It is necessary to keep an accurate account in a route book of the milk and cream sold to each customer each day. The total quantity of milk and cream sold each day, plus the amount returned to the cooler, should be checked daily against the total amount taken out by the driver. The amount of cash collected on the route, plus the value of the milk sold on account, should also be checked against the total value of the milk delivered. This should be done daily when the driver comes back from making his deliveries. In larger businesses the losses from neglect of such checking may easily be greater than the salary of an office clerk.

ANALYSIS OF THE FARM BUSINESS

A study of the business operations of producer-distributors would not be complete unless the farm and the milk business were analyzed as an entire unit. A producer-distributor is interested in making the largest income for his labor and capital, regardless of whether he makes it by producing milk or by marketing it. In the organization and management of such businesses numerous questions arise. Is it more profitable to buy or to produce the additional milk needed for the retail business? Do the distributors who produce their entire supply of milk make more money than those who rely heavily on purchases of milk from other farmers to supplement their own supply? How is the efficiency of the entire business affected by changes in the efficiency of the milk-distribution business? What effect has a reduction in the cost of retailing on labor income? Should a producer-distributor grow a large amount of cash crops or should he confine his work largely to the production and distribution of milk? Is labor efficiency more important in the distribution than in the production of milk? A brief study was made of the combined farm and milk businesses in order to provide facts that might be useful in helping a producer-distributor make decisions in regard to such problems.

FARM ORGANIZATION AND LABOR INCOME

Use of land

The size of farms studied varied from 28 acres in the Long Island area to 215 acres in the central New York area (table 60). Nearly half the land was in crops, about one-third in open pasture, and about 6 per cent in woods pastured. The other land was in woods, farmstead, roads, idle, and waste land. A larger percentage of the total land was in crops and a smaller percentage in pasture in the upstate areas, than on Long Island. Because of the small total acreage on Long Island farms, there was an average of only 15 acres of pasture per farm.

Crops grown

In all of the upstate areas, hay was the most important crop and was grown on about one-half of the crop land (table 61). Grain crops were raised on about one-fourth, and corn silage on about one-fifth of the crop land in the upstate areas. Cash crops were relatively unimportant in all areas and were grown on only about two and one-half per cent of the crop area. There were less than ten acres of crop land per farm in the Long Island area and from 50 to 100 acres in crops in the other areas. Ap-

TABLE 60. UTILIZATION OF LAND, 81 PRODUCER-DISTRIBUTORS, 1935–36

Uses	James-town	Central New York	Capital district	Long Island	All areas
	Acres per farm				
Crops	58.4	99.4	91.2	8.6	65.0
Open pasture	49.2	60.2	43.0	14.6	43.3
Woods pastured	11.1	14.3	5.8	....	8.6
Woods not pastured	6.1	22.1	22.3	2.4	13.2
Farmstead, roads, idle land, and waste	5.6	19.3	10.2	2.4	10.1
Total	130.4	215.3	172.5	28.0	140.2
	Per cent of total				
Crops	44.8	46.2	52.9	30.7	46.4
Open pasture	37.7	28.0	24.9	52.1	30.9
Woods pastured	8.5	6.6	3.4	....	6.1
Woods not pastured	4.7	10.3	12.9	8.6	9.4
Farmstead, roads, idle land, and waste	4.3	8.9	5.9	8.6	7.2
Total	100.0	100.0	100.0	100.0	100.0

TABLE 61. ACREAGES OF CROPS GROWN, 81 PRODUCER-DISTRIBUTORS, 1935–36

Crops	James-town	Central New York	Capital district	Long Island	All areas
	Average acres per farm				
Corn for silage	12.3	21.0	20.2	5.7*	14.8
Corn for grain	0.8	0.9	1.5	....	0.8
Hay	30.4	46.3	45.2	2.3	31.2
Grain	11.0	27.1	19.8	0.4	15.1
Cash crops	1.5	2.7	1.4	....	1.5
Other crops	2.4	1.4	3.1	0.2	1.6
Total crops	58.4	99.4	91.2	8.6	65.0
	Per cent of crop area				
Corn for silage	21.1	21.1	22.1	66.3	22.8
Corn for grain	1.4	0.9	1.7	....	1.2
Hay	52.0	46.6	49.6	26.7	48.0
Grain	18.8	27.3	21.7	4.7	23.2
Cash crops	2.6	2.7	1.5	....	2.3
Other crops	4.1	1.4	3.4	2.3	2.5
Total crops	100.0	100.0	100.0	100.0	100.0

*This includes an average of 1.8 acres of green corn.

parently, producer-distributors have discovered that they can spend their time more profitably in retailing milk than in the production of cash crops.

Numbers of livestock

There was little livestock other than cows and heifers kept on the farms of the distributors interviewed (table 62). There was an average of about 28 cows, 11 heifers, and one herd bull per farm. There were also 3 to 4 horses, a small flock of hens, and a few hogs. The smallest herds were found in the Long Island area and the largest in the central New York area. Relatively few heifers were found on the Long Island farms compared with the upstate areas. The number of cows per farm varied from 5 to 102. More than half of the distributors interviewed on Long Island kept herds of 20 cows or less.

TABLE 62. NUMBERS OF LIVESTOCK, 81 PRODUCER-DISTRIBUTORS, 1935–36

Kind of livestock	James-town	Central New York	Capital district	Long Island	All areas
	Average number per farm				
Cows	26.5	33.6	26.4	22.0	27.7
Heifers (1 year old or more)	5.7	8.8	6.4	1.4	5.8
Heifers (less than 1 year)	5.3	8.3	4.6	1.9	5.4
Herd bulls	1.0	1.3	1.1	0.9	1.1
Bull calves	0.2	0.1	0.1	0.1	0.1
Horses	2.8	3.9	3.6	0.6	2.8
Hogs	1.2	2.0	5.6	0.1	1.9
Hens	55.0	105.1	123.0	6.3	70.6

Distribution of capital

An average of about $26,000 was invested per farm for the 81 farms studied (table 63). This comprised real estate, livestock, farm machinery, feeds and supplies, buildings, equipment, and accounts receivable.[1] Little difference was found between areas in the amount of total capita invested, but there was some difference in the distribution of capital More of the capital on the Long Island farms was invested in real estat and less in livestock, equipment, and supplies. For all areas, about two thirds of the total capital was invested in real estate, about one-sixth eac in livestock and the retail milk business. Less than 10 per cent of th total capital in any area was invested in farm machinery, feed, an supplies.

TABLE 63. DISTRIBUTION OF TOTAL CAPITAL, 81 PRODUCER-DISTRIBUTORS, 1935–36

Item	James-town	Central New York	Capital district	Long Island	All areas
	Amount per farm				
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Real estate*	15,193	15,656	17,724	18,141	16,482
Milk distribution capital†	3,369	5,121	4,529	2,494	3,923
Livestock	3,141	6,686	3,889	2,939	4,393
Farm machinery and tools	1,307	1,829	1,730	339	1,309
Feed and supplies	133	558	219	....	256
Total	23,143	29,850	28,091	23,913	26,363
	Proportion of total				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Real estate*	65.6	52.4	63.1	75.9	62.5
Milk-distribution capital†	14.6	17.2	16.1	10.4	14.9
Livestock	13.6	22.4	13.8	12.3	16.7
Farm machinery and tools	5.6	6.1	6.2	1.4	4.9
Feed and supplies	0.6	1.9	0.8	....	1.0
Total	100.0	100.0	100.0	100.0	100.0

*Does not include value of milk plant.
†Includes accounts receivable.

Source of receipts

The total gross income amounted to approximately $15,000 per far for the 81 farms on which complete records were obtained (table 64).

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[1] Accounts receivable consisted of past-due milk accounts.

TABLE 64. SOURCES OF FARM RECEIPTS, 81 PRODUCER-DISTRIBUTORS, 1935–36

Source	Jamestown	Central New York	Capital district	Long Island	All areas
	Amount per farm				
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Retail sales*	10,243	14,427	17,229	11,054	12,959
Livestock sales	483	1,027	731	294	658
Increase in inventory	462	1,145	807	470	747
Crop sales	266	236	95	....	163
Miscellaneous	70	736	87	160	317
Total	11,524	17,571	18,949	11,978	14,844
	Proportion of total				
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Retail sales*	88.9	82.1	90.9	92.3	87.3
Livestock sales	4.2	5.9	3.9	2.5	4.4
Increase in inventory	4.0	6.5	4.3	3.9	5.0
Crop sales	2.3	1.3	0.5	....	1.1
Miscellaneous	0.6	4.2	0.4	1.3	2.2
Total	100.0	100.0	100.0	100.0	100.0

*Includes all milk, cream, and other products sold through the retail milk business.

Nearly $13,000 per year, or about 90 per cent of the gross income per farm, was from sales of milk, cream, and other products sold through the retail milk business. Practically all of these sales were milk or cream. Income from sales other than retail sales was more important in the upstate areas than in the Long Island area.

Distribution of expenses

Labor was the most important item of expense for all areas, and amounted to $2623 per farm, or nearly one-fourth of the total farm expenses (table 65). Purchased feed, most of it for cows, was the next largest item, and amounted to $1969 per farm. Purchases of milk, cream, and other products for resale on the milk route were the third largest item, and amounted to $1903 per distributor. Other groups of expenses, in order of importance, were: machinery, truck, automobile, gasoline, and oil; milk-room equipment and supplies, livestock; buildings; publicity, bad debts, and licenses; taxes; water and electricity; fertilizer, seeds, and sprays; veterinary and miscellaneous supplies; and inventory decrease. Two-thirds of all farm expenses were for labor, feed, milk and cream, machinery, trucks, and gasoline and oil.

Summary of farm earnings

The difference between the farm income and farm expenses represents the amount the operator had left for his year's work and interest on the capital invested in the business. This averaged $3245 per year for all areas (table 66). The central New York area had the largest income, and the Long Island area the smallest income for capital and operator's labor. If interest is charged on the average capital at 5 per cent, and this sum deducted from the income for capital and operator's labor, the remainder is called labor income and represents the amount the operator received for his year's work in addition to a house to live in and farm

TABLE 65. FARM AND MILK-DISTRIBUTION EXPENSES OF 81 PRODUCER-DISTRIBUTORS, 1935–36*

Item	Jamestown	Central New York	Capital district	Long Island	All areas
Number of farms	21	27	13	20	81
	Amount per farm				
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Hired and unpaid labor	1,832	3,229	3,044	2,364	2,623
Cattle and other feed	1,106	1,837	1,727	3,211	1,969
Milk, cream, and by-products	1,606	1,547	4,784	823	1,903
Machinery, truck, automobile†, gasoline, oil	869	1,492	1,534	811	1,168
Milk-room equipment and supplies	684	978	1,022	775	860
Livestock	547	1,154	860	741	847
Buildings	610	860	860	372	675
Publicity, bad debts, and licenses‡	339	517	501	390	438
Taxes	126	229	208	335	225
Water rent, electricity	138	224	272	183	199
Fertilizer, seeds, sprays	170	235	239	70	178
Veterinary and miscellaneous supplies§	72	187	108	110	125
Inventory decrease	155	117	121	102	124
All other	115	537	122	144	264
Total expenses	8,369	13,141	15,402	10,431	11,598

*A detailed list of farm expenses is given in the Appendix, table 80.
†Includes both milk business and farm trucks.
‡Includes telephone and office supplies.
§Includes horseshoeing, strainer cottons, pails, cans, etc.

TABLE 66. SUMMARY OF CAPITAL RECEIPTS, EXPENSES, AND PROFIT, 81 PRODUCER-DISTRIBUTORS, 1935–36

Item	Jamestown	Central New York	Capital district	Long Island	All areas
	Average amount per farm				
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Average capital	23,143	29,850	28,091	23,913	26,363
Total farm receipts	11,524	17,571	18,949	11,978	14,844
Total farm expenses	8,369	13,143	15,402	10,431	11,599
Income for capital and operator's labor	3,155	4,428	3,547	1,547	3,245
Interest on average capital at 5 per cent	1,157	1,492	1,405	1,196	1,318
Labor income	1,998	2,935	2,142	352	1,927
Value of operator's labor	971	1,180	1,114	1,394	1,168
Return on capital	2,184	3,248	2,433	154	2,077
Per cent return on capital	9.4	10.9	8.7	0.6	7.9

produce to use in the household. The average income varied from $2935 in the central New York area to $352 in the Long Island area.

Variations in labor incomes

The average labor income of the producer-distributors included in this study was higher than that of any group of farms that have been included in a farm-management survey by the Department of Agricultural Economics at Cornell University since 1907. In spite of this fact, 20 per cent of these farms made a minus labor income (table 67). Approximately 14 per cent made a labor income of $5000 or more. The highest labor income made by any distributor was $13,438; the lowest, a loss of $7648.

TABLE 67. VARIATION IN LABOR INCOMES, 81 PRODUCER-DISTRIBUTORS, 1935–36

Labor income	Number of farms	Percentage of total
Less than –$4,001	3	4
–$4,000 to –$3,001	0	0
–$3,000 to –$2,001	2	3
–$2,000 to –$1,001	5	6
–$1,000 to –$1	6	7
0 to $999	17	21
$1,000 to $1,999	14	17
$2,000 to $2,999	6	7
$3,000 to $3,999	11	14
$4,000 to $4,999	6	7
$5,000 to $5,999	7	9
$6,000 or more	4	5
Total	81	100

This extremely wide range in the success of these businesses probably is due in part to the fact that this type of business is ordinarily larger in size than that of the average dairy-farm business. The average man-equivalent of the 81 farms for which records are available was 4.3 (table 68). This is more than twice the average for New York farms. Although there is an opportunity to make more money on a large farm than on a small farm, there is also a chance to make a large loss, if prices are unfavorable or if the business is not well managed. On a large farm, a greater proportion of the expense, especially the expense for labor, is a cash cost.

TABLE 68. AVERAGE AND RANGE OF VARIOUS FARM-MANAGEMENT FACTORS, 81 PRODUCER-DISTRIBUTORS, 1935–36

Factor	High	Low	Average
Size of business (including milk distribution):			
Man equivalent	19.1	1.2	4.3
Productive-man work units per farm*	5,930	164	1,206
Average number of cows per farm†	102	4	28
Total capital per farm (dollars)	100,000	5,500	26,363
Quarts of milk retailed per year	856,090	11,780	119,347
Type of business:			
Per cent of work units on cows	63	9	34
Per cent of work units on retail milk	84	8	49
Per cent of milk supply produced	100	18	72
Efficiency of labor and production:			
Work units per man	551	96	282
Quarts of milk sold per man per day (all labor)	......	......	76
Quarts of milk sold per hour of labor (milk distribution labor only)	52	4	20
Pounds of milk produced per cow	11,800	3,400	6,655
Operating cost per quart of milk sold (cents)	9.2	1.6	4.1
Measures of earnings (dollars)			
Return per hour of labor on retail milk	1.34	–.06	.60
Total labor return on retail milk per farm	19,708	–627	3,511
Net profit on retail milk per farm	10,960	–2,720	1,270
Labor income per farm	13,438	–7,648	1,927

*A productive-man-work unit is the amount of directly productive work accomplished by a man in 10 hours. For example, it takes an average of 10 hours to cut and harvest an acre of hay once; so each acre of hay is considered as one productive-man-work unit per cutting. Each quart of milk equivalent retailed per day for a year represents approximately 2 man-work-units. A dairy with an average of 200 quarts retailed per day would have 400 work units on retail milk. The work-unit requirements for other farm enterprises are given in the Appendix, table 81, page 83.

†Average of beginning and ending inventories.

RELATION OF THE RETAIL MILK ENTERPRISE TO THE FARM BUSINESS

About half of the labor force on the farms of the producer-distributors for whom complete records were available was used in the operation of the retail business, and one-third in the production of milk (table 68). Only one-sixth of the total labor was used for other farm enterprises. Three-fourths of the 326 quarts of milk retailed per day was produced on the distributor's farm, and one-fourth was purchased. On the basis of this proportion of the milk produced, the average output per man, for the entire labor force, was 76 quarts, or nearly two 40-quart cans of milk a day. This included all work for the production and retailing of milk as well as the time spent on the other farm enterprises. This figure varied according to the percentage of the milk produced and the amount of time spent on other farm enterprises. The average output of milk, for the time spent on the retail enterprise only, was 20 quarts per hour; or based on an 8-hour day, 160 quarts, or 4 cans per man per day.

Most of the labor income of the 81 farmers was derived from the retail milk enterprise. The average net profit from this business amounted to $1270, compared with a labor income from the entire farm business of $1927. Net profit is not comparable with labor income because the former is exclusive of charges for operator's labor and privileges.

Relation of size of retail enterprise to labor income

It has been shown that the earnings of the retail-milk business play an important part in the earnings of the farm business as a whole. In the

TABLE 69. RELATION OF THE VOLUME OF BUSINESS OF THE RETAIL MILK ENTERPRISE TO LABOR INCOME AND OTHER FACTORS, 81 PRODUCER-DISTRIBUTORS, 1935-36

Item	Milk retailed per year		
	Less than 58,000 quarts	58,000 to 117,000 quarts	More than 118,000 quarts
Number of farms	27	27	27
Size of business (including milk distribution):			
Man equivalent per farm	2.5	4.0	6.3
Work units per farm	533	1,019	2,067
Number of cows per farm	14	28	41
Quarts of milk retailed per year	36,966	86,444	234,632
Type of business:			
Per cent work units on retail milk	35	42	57
Per cent work units on cows	40	41	30
Per cent milk supply produced	96	88	62
Efficiency of labor and production:			
Work units per man	213	254	327
Quarts of milk sold per man per day*	40	59	102
Quarts of milk sold per hour of labor†	14	17	24
Production per cow (pounds)	5,390	5,893	7,609
Net operating cost per quart of milk sold (cents)	5.1	4.4	3.9
Measures of earnings			
Return per hour of labor on retail milk (cents)‡	44	53	67
Total labor returns on retail milk (dollars) §	1,198	2,723	6.611
Net profit on retail milk (dollars)	269	941	2,599
Labor income (dollars)	507	1,663	3,611

*Based on total labor for farm and milk business.

†Based on labor for milk business only.

‡Return per hour of labor is the sum of net profit and the cost of hired and unpaid labor, divided by the total hours of labor used in the milk-retailing business.

§Total labor return is the sum of net profit and the cost of hired and unpaid labor.

smaller businesses a lesser share of the total income was derived from the retail-milk enterprise. The 27 farms that retailed less than 58,000 quarts of milk a year had a net profit of $269 from retail milk, and a labor income of $507. This compares with a net profit of $2599 and a labor income of $3611 for the 27 men who retailed more than 118,000 quarts per year (table 69). One reason for this difference is that the farms with the larger retail-milk businesses buy a larger proportion of the milk they sell. Therefore, a larger proportion of the time of the labor force is spent on retail milk than on the other farm enterprises. Because the return per hour of labor for the retail-milk enterprise is higher than that of most other farm enterprises, it is to be expected that a larger income would be made with the larger milk business.

Relation of size of business and percentage of the total volume of business on retail milk to labor income

It is generally true that the larger the proportion of the total farm business made up of retail milk, the larger the labor income. This was true even with farms of the same size (table 70). Apparently it was more profitable for a farmer to spend his time retailing milk than to spend it milking cows or doing other farm work. The distributors who spent 45 per cent or more of their time on retail milk made a labor income

TABLE 70. RELATION OF SIZE OF BUSINESS AND PERCENTAGE OF THE TOTAL VOLUME OF BUSINESS ON RETAIL MILK TO LABOR INCOME AND OTHER FACTORS, 81 PRODUCER-DISTRIBUTORS, 1935–36

Item	Less than 700 work units per farm		700 to 1,260 work units per farm		1,261 or more work units per farm	
	Per cent work units on retail milk		Per cent work units on retail milk		Per cent work units on retail milk	
	Less than 45	45 or more	Less than 45	45 or more	Less than 43	43 or more
Number of farms	13	14	13	14	13	14
Size of business (including milk distribution):						
Man equivalent per farm	2.4	2.4	4.0	4.4	5.3	7.2
Work units per farm	420	523	963	1,039	1,662	2,588
Number of cows per farm	11	14	27	23	44	47
Quarts of milk retailed per year	26,582	55,434	65,050	116,723	124,398	317,754
Type of business:						
Per cent work units on retail milk	28	53	34	56	37	61
Per cent work units on cows	36	40	42	33	40	27
Per cent milk supply produced	90	87	94	69	97	55
Efficiency of labor and production:						
Work units per man	177	218	244	238	313	359
Quarts milk sold per man per day*	30	63	44	72	64	121
Quarts of milk sold per hour of labor†	11	14	16	16	20	28
Production per cow (pounds)	4,633	7,329	4,902	7,613	5,826	7,966
Net operating cost per quart of milk sold (cents)	5.4	5.5	4.4	5.1	3.8	3.5
Measures of earnings:						
Return per hour of labor on retail milk (cents)	21	56	50	49	61	75
Total labor returns on retail milk (dollars)	518	2,097	2,047	3,604	3,776	8,526
Net profit on retail milk (dollars)	20	581	588	841	1,870	3,622
Labor income (dollars)	476	872	1,125	1,922	1,647	5,339

*Based on total labor for farm and milk business.
†Based on labor for milk business only.

about twice as large as that of the distributors who spent less than 45 per cent of their time on retail milk. In each size group the farmers who spent the smallest amount of time on retail milk produced practically their entire milk supply. Apparently it was more profitable to increase the size of the farm business by purchasing milk and expanding the retail enterprise than to expand the dairy herd or other farm enterprises.

Relation of size of business and percentage of total volume of business on cows to labor income

In most of the farm-management surveys of dairy farms that have been made in this State a rather close relationship has been shown between the number of cows kept and labor income. When the farms in this study were grouped into two size groups, those with more than 1090 and those with less than 1090 work units per farm, it was found that within these groups an increase in the proportion of the total work spent on cows resulted in a decrease in labor income (table 71). The farms with the larger percentage of the total work units on cows kept more cows per farm but had a somewhat smaller total volume of business than that of those farms with a smaller percentage of work on cows. The former group produced a larger proportion of the total supply of milk, and, therefore, spent a smaller proportion of their time on the retailing end of the business. Likewise the groups with the largest percentage of total

TABLE 71. RELATION OF SIZE OF BUSINESS AND PERCENTAGE OF TOTAL VOLUME OF BUSINESS ON COWS TO LABOR INCOME AND OTHER FACTORS, 81 PRODUCER-DISTRIBUTORS, 1935–36

Item	Less than 1,090 work units per farm			1,090 or more work units per farm		
	Per cent work units on cows			Per cent work units on cows		
	Less than 39	39 to 43	44 or more	Less than 30	30 to 39	40 or more
Number of farms	14	13	14	13	14	13
Size of business (including milk distribution):						
Man equivalent per farm	2.9	2.8	2.9	6.6	5.9	4.8
Work units per farm	648	599	559	2,288	1,731	1,464
Number of cows per farm	13	16	18	35	41	44
Quarts of milk retailed per year	58,304	56,725	39,057	296,787	153,264	120,212
Type of business:						
Per cent of work units on retail milk	45	47	35	65	44	41
Per cent of work units on cows	31	41	49	23	35	45
Per cent milk supply produced	81	94	99	46	85	94
Efficiency of labor and production:						
Work units per man	225	218	195	348	293	305
Quarts pf milk sold per man per day*	55	55	37	123	71	68
Quarts of milk sold per hour of labor†	15	17	12	26	20	19
Production per cow (pounds)	7,534	6,972	4,532	8,516	6,880	5,513
Net operating cost per quart of milk sold (cents)	4.7	5.2	5.4	3.6	3.9	4.4
Measures of earnings:						
Return per hour of labor on retail milk (cents)	42	63	41	65	68	57
Total labor returns on retail milk (dollars)	1,686	2,154	1,329	7,305	5,182	3,589
Net profit on retail milk (dollars)	454	608	224	2,768	2,460	1,154
Labor income (dollars)	1,799	1,008	496	3,783	3,469	1,009

*Based on total labor for farm and milk business.
†Based on labor for milk business only.

work units on cows retailed a much smaller total quantity of milk than did those with the smallest percentage of work units spent on cows. This resulted in a higher operating cost per quart of milk and lower net profit for the retail business. The smaller net profit from the retail business is reflected in the lower labor income.

Relation of labor efficiency and percentage of farm business on retail milk to labor income

Efficiency in the use of labor is more important on farms with a large percentage of the total work units on retail milk than it is on farms with a smaller percentage of the time spent on retail milk (table 72). An increase in labor efficiency from 190 to 342 work units per man on farms with less than 45 per cent of the work on retail milk was accompanied by an increase in labor income from $808 to $1619. A similar increase in labor efficiency on the farms with more than 45 per cent of the work units on retail milk was accompanied by an increase from $374 to $5663.

TABLE 72. RELATION OF LABOR EFFICIENCY AND PERCENTAGE OF FARM BUSINESS ON RETAIL MILK TO LABOR INCOME AND OTHER FACTORS, 81 PRODUCER-DISTRIBUTORS, 1935–36

Item	Less than 45 per cent of work units on retail milk			45 per cent or more of work units on retail milk		
	Work units per man			Work units per man		
	Less than 210	210 to 294	295 or more	Less than 219	219 to 309	310 or more
Number of farms	14	13	14	13	14	13
Size of business (including milk distribution):						
Man equivalent per farm	3.5	3.8	4.5	4.0	3.5	6.4
Work units per farm	675	972	1,556	767	887	2,419
Number of cows per farm	18	27	41	19	20	42
Quarts of milk retailed per year	51,503	62,292	117,584	81,255	95,222	315,438
Type of business:						
Per cent work units on retail milk	38	32	38	53	54	65
Per cent work units on cows	39	42	39	37	34	26
Per cent milk supply produced	93	98	94	74	78	51
Efficiency of labor and production:						
Work units per man	191	256	342	190	254	380
Quarts milk sold per man per day*	40	45	71	56	74	135
Quarts milk sold per hour of labor†	16	14	22	15	16	28
Production per cow (pounds)	5,829	4,872	5,861	6,865	7,908	8,254
Net operating cost per quart of milk sold (cents)	4.5	4.4	3.7	5.2	5.1	3.6
Measures of earnings:						
Return per hour of labor on retail milk (cents)	58	45	59	50	53	73
Total labor returns on retail milk (dollars)	1,889	1,986	3,184	2,730	3,104	8,353
Net profit on retail milk (dollars)	791	829	1,324	512	804	3,425
Labor income (dollars)	808	892	1,619	374	2,289	5,663

*Based on total labor for farm and milk business.
†Based on labor for milk business only.

Labor efficiency is more important on farms with a large than with a small proportion of the productive work spent retailing milk, probably because the cost of labor is a larger proportion of the total cost of retailing milk than of the cost of producing it. In a survey of the cost of producing milk in Orange County, New York, in 1931, it was found that labor amounted to about one-fourth of the total cost of production.[12] Labor constitutes about one-half the total cost of distributing milk.

Relation of cost of retailing milk and percentage of farm business on retail milk to labor income

The cost of retailing milk had an inverse relationship to the labor income of the farms included in this study (table 73). This relationship was more pronounced for the farms on which a larger proportion of the total farm business was made up of the retail-milk enterprise. On the farms where retail milk constituted less than 45 per cent of the total volume of business, a decrease of 2.9 cents in the cost of retailing resulted in increasing the labor income from –$395 to $2252. A similar relationship was shown for the farms with a larger proportion of the total business in the retail-milk enterprise. The increase in labor income with a decrease in the cost of retailing per quart is due both to the higher profit per quart and to the larger number of quarts of milk handled by these distributors. The distributors with the highest cost per quart of milk earned a smaller return per hour of labor spent on retail milk and a smaller net profit than did the distributors with a low distribution cost. Ap-

TABLE 73. RELATION OF COST OF RETAILING MILK AND PERCENTAGE OF FARM BUSINESS ON RETAIL MILK TO LABOR INCOME AND OTHER FACTORS, 81 PRODUCER-DISTRIBUTORS, 1935–36

Item	Less than 45 per cent of work units on retail milk			45 per cent or more of work units on retail milk		
	Cost of retailing per quart (cents)			Cost of retailing per quart (cents)		
	Less than 3.6	3.6 to 4.8	4.9 or more	Less than 3.9	3.9 to 5.5	5.6 or more
Number of farms	14	13	14	13	14	13
Size of business (including milk distribution):						
Man equivalent per farm	3.7	5.1	3.2	5.3	4.9	3.6
Work units per farm	1,193	1,333	702	1,885	1,375	775
Number of cows per farm	30	34	22	32	28	20
Quarts of milk retailed per year	89,026	102,895	42,358	241,422	162,076	83,275
Type of business:						
Per cent work units on retail milk	37	39	30	64	59	54
Per cent work units on cows	37	38	47	26	31	39
Per cent milk supply produced	94	94	100	47	67	88
Efficiency of labor and production:						
Work units per man	322	261	221	353	282	217
Quarts of milk sold per man per day*	66	55	36	124	90	63
Quarts milk sold per hour of labor†	23	18	12	28	22	13
Production per cow (pounds)	6,110	6,044	4,113	7,594	8,185	7,731
Net operating cost per quart of milk sold (cents)	3.0	4.1	5.9	2.8	4.7	6.9
Measures of earnings:						
Return per hour of labor on retail milk (cents)	61	65	30	77	64	40
Total labor return on retail milk (dollars)	2,330	3,795	1,062	6,655	4,784	2,618
Net profit on retail milk (dollars)	1,256	1,971	–201	3,585	1,480	–376
Labor income (dollars)	2,252	1,505	–395	5,656	2,099	585

*Based on total labor for farm and milk business.
†Based on labor for milk business only.

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[12] Seasonal costs and returns in producing milk in Orange County, New York. By L. C. Cunningham. Cornell Univ. Agr. Exp. Sta. Bul. 641 (Reference on p. 19) 1936.

parently the methods of obtaining low cost and high profits from the retail-milk enterprise as previously outlined in this report would be effective in building up a larger labor income for the operator.

SUMMARY AND CONCLUSIONS

The distribution of milk by producer-distributors differs from that of dealer-distributors in several ways. First, the producer-distributor's plant is located on the farm, and farm labor is used for many of the operations, both in the plant and on the route. Again, much of the milk is produced by the distributor's herd rather than purchased from farmers. Also the volume of business of producer-distributors generally is smaller than that of the dealer-distributors.

AREAS STUDIED

Four New York State areas were selected for this study: the Jamestown area, the central New York area, the Capital District, and the Long Island area. Both retail and wholesale milk prices were lower and there were fewer alternative farm enterprises in the Jamestown area than in the other upstate areas. The other areas were situated closer to New York City and had better fluid-milk outlets. They also had more opportunity to grow cash crops. This resulted in somewhat less desire to retail milk. Retail milk prices were 3 to 4 cents higher on Long Island than in the upstate areas. Both milk production and distribution costs were higher there than in the upstate areas. Because of the relatively small cities and the scattered suburban population, it was difficult for the distributors on Long Island to develop a satisfactory volume of business and to have low costs.

SALES ANALYSIS

The average sales of the 92 producer-distributors included in this study were slightly less than 350 quarts of milk equivalent, and amounted to $37 daily.

A majority of the distributors handled only milk and cream. Those with the larger volumes handled a number of different by-products. For all distributors, about 80 per cent of the milk supply was utilized as fluid milk and 20 per cent as cream and by-products. Sixty-four per cent of these sales were made at retail prices. Thirty-six per cent were made to wholesale customers and to other milk dealers. Fluid-milk sales constituted a larger proportion of the business of raw-milk distributors than for the pasteurizing distributors. The former group also had the largest proportion of sales to retail customers.

During the period covered by this survey the prices charged consumers and others for milk and cream were set by the New York Milk Control Division. In some instances, particularly in the cities in the surplus-milk areas, these prices seemed to be somewhat higher than justified by market conditions. The average selling price per quart of milk equivalent handled by the distributors in the study ranged from nearly 16 cents to slightly more than 8 cents, and averaged 10¾ cents per quart.

Relatively small variation was found in the total sales of milk equivalent throughout the year. The peak of sales in May was only 12 per cent higher than the low point in October. Seasonal variation in the sales of milk was less pronounced than in the sales of cream. The greatest seasonal variation in cream sales was found on Long Island. In this area vacation trade from New York City increased the daily sales of cream in June, July, and August to two and one-half times the sales in December, January, and February.

MILK SUPPLY

Two-thirds of the milk supply was produced by the distributors' own herds, one-fourth was purchased from farmers, and less than 10 per cent was purchased from other dealers. The average butterfat test of the milk supply as reported to the New York Milk Control Division was just under 4 per cent. In computing costs and profits the milk produced was valued on the basis of the minimum prices established by the Division of Milk Control, while the milk purchased was valued according to the actual prices paid.

The quantity of milk produced in the distributor's herd varied but little according to the season. Peak production in June was 12 per cent above the daily average production for the year, and in January, the low point, it was 8 per cent below average.

CAPITAL

An average of $4042 was invested in the milk-distribution enterprise including $800 in accounts receivable. The pasteurizing distributors had three and one-third times as much capital invested as had the distributors of raw milk. An extra investment averaging $3000 was made by distributors who had recently converted raw-milk plants to pasteurizing plants. About $2000 of this was for plant equipment and $1000 for buildings.

COSTS AND PROFITS

The average cost of distributing a quart of milk equivalent by these producer-distributors was 4.0 cents. This includes cash as well as noncash items, such as unpaid labor, and 5 per cent interest on the capital invested in the business. This should not be confused with the cost of distributing a quart of milk to family trade. The cost of distributing retail milk in quart bottles was slightly over 5 cents a quart. Approximately one-half of the total distribution cost was for selling and delivery, and slightly more than one-third for plant operation. The remainder of the costs were for containers and administrative items. When the costs were classified by type of expenditure, labor costs were nearly one-half; supplies and purchased services were about one-fourth; and items such as interest, taxes, and insurance, were about one-fourth of the total cost.

FACTORS AFFECTING COSTS AND PROFITS

There was a wide variation in profits. The largest profit made by any distributor was $11,446. The largest loss was $2717. On the basis of a quart of milk sold, the results varied from a profit of 4½ cents to a loss of nearly 3 cents. Costs varied from less than 2 cents to more than 9 cents per quart.

The most important factor affecting the profits of the businesses studied was the volume of milk handled. Labor efficiency had the greatest effect on costs of operation. In general, the distributors with the largest volume had the largest profits and lowest costs. The volume of business of a distributor was dependent to a large degree on the size of the market in which he was retailing.

The five most important factors affecting costs and profits were volume of business, labor efficiency, compactness of route, size of load, and capital efficiency. Seven of the distributors were above average in all these factors. Their average net operating cost was only 2.7 cents per quart, and their average profit was $4729. Those distributors that were below average in all these factors had an average cost of 6.2 cents per quart, and suffered an average loss for the year of $262.

Nearness to market, good road, convenient layout of plant, and good records are other factors favoring success in this kind of business.

RELATION OF THE RETAIL ENTERPRISE TO THE FARM BUSINESS

The farm operations of the producer-distributors consisted principally of an intensive milk-production enterprise to supply the needs of the retail route. Hay and silage corn were the principal crops grown. Little livestock, other than cows and heifers, was kept.

An average of about $26,000 was invested in the farm, of which $4000 was for the milk-distribution business. The gross receipts of the milk-distribution business constituted nearly 90 per cent of the $15,000 annual gross farm receipts.

The producer-distributors included in this study received an average income, above all business expenses, of $1927 for their year's work in addition to having a house to live in and farm products to use in the household. One of these operators made a labor income of $13,438, and ten others made more than $5000. One failed by $7648 to get any return for his time, and 15 others also suffered losses. This type of business presents opportunities for making a large gain or a large loss.

In general, producer-distributors who spent the largest proportion of their time on the retail-milk enterprise had the largest labor incomes. Results of this study indicate that most producer-distributors desiring to increase their business can do so more profitably by enlarging the retail-milk enterprise than by keeping more cows.

APPENDIX

TABLE 74. MINIMUM RETAIL AND WHOLESALE MILK AND CREAM PRICES ESTABLISHED BY NEW YORK DIVISION OF MILK CONTROL FOR LONG ISLAND AND UPSTATE AREAS, 1935–36*

Product	Prices for sales of milk at–		Product	Prices for sales of cream at–	
	Retail	Wholesale†		Retail	Wholesale†
Schedule of prices for the Long Island area (cents)					
Grade A pasteurized milk:			Heavy cream:		
Quarts	16	13¾	Quarts	74	58
Pints	10	8	Pints	41	34
Half-pints	..	4¾	Half-pints	21	18
Bulk‡	..	11	Bulk‡	..	53
Grade B pasteurized milk:			Medium cream:		
Quarts	13	10¾	Quarts	61	48
Pints	8	6	Pints	34	28
Half-pints	..	3¾	Half-pints	18	16
Bulk‡	..	9	Bulk‡	..	43
Grade A raw milk:			Light cream:		
Quarts	15	13	Quarts	47	36
Pints	10	8	Pints	27	21
Half-pints	..	4½	Half-pints	15	12
Bulk‡	..	9	Bulk‡	..	30
Schedule of prices for upstate areas (cents)					
Milk (Schedule A):§			Heavy cream:		
Quarts	12	10	Quarts	74	66
Pints	7	6	Pints	41	36
Half-pints	4	3½	Half-pints	21	19
Bulk‡	..	9	Bulk‡	..	57
Milk (Schedule B):			Medium cream:		
Quarts	11	9	Quarts	61	51
Pints	7	6	Pints	34	28
Half-pints	4	3½	Half-pints	18	16
Bulk‡	..	8	Bulk‡	..	48
Milk (Schedule C):			Light cream:		
Quarts	10	8	Quarts	47	38
Pints	6	5	Pints	27	21
Half-pints	3	3	Half-pints	14	12
Bulk‡	..	7	Bulk‡	..	35

*Data supplied by the Division of Milk Control at Albany, New York. Cream prices were changed during the period of the survey, but the prices given in this table were in effect during the greater part of the period.

†Does not include sales to other dealers or sales made at the distributor's plant to retail or wholesale customers.

‡For sales in less than 40-quart lots.

§There were three schedules of milk prices for upstate cities and villages, depending upon the size and location of the city or village. (Official Order No. 80, Division of Milk Control, New York State Dept. Agr. and Markets.)

TABLE 75. DIFFERENCES IN SANITARY REQUIREMENTS FOR THE VARIOUS GRADES OF MILK (AS SPECIFIED IN CHAPTER III OF THE STATE SANITARY CODE OF NEW YORK STATE AS AMENDED JULY 1, 1937)

(Requirements identical for all grades are not listed)

	Grade-A pasteurized	Grade-B pasteurized	Certified and Certified-pasteurized*	Special-A raw	Grades A and B raw†
Bacteria counts:					
As delivered to consumer	30,000	50,000	10,000	10,000	30,000
Before pasteurization	100,000	300,000‡	.....	.....	.....
Counts made every—	3 months	3 months	week	week	3 months
Cows:					
Tuberculin test every—	.....	.....	6 months	12 months	12 months
Bang abortion diseases test every—	.....	.....	3 months§	3 months§	3months§
Veterinary examination‖ every—	6 months	12 months	month	3 months	12 months
Use strip cup each milking	Yes	.....	Yes	Yes	.....
Clip flank, udders, tail	Yes	.....	Yes	.....	.....
Milk handlers:					
Laboratory examination of body discharges	¶	¶	Before employment	Before employment**	¶
Weekly physical examination	.....	.....	Yes	.....	
Temperature:					
Delivery at plant	50° F.	60° F.	50° F.	50° F.	50° F.
Delivery on street	50° F.	50° F.	50° F.	50° F.	50° F.
Delivery within—	36 hours	48 hours	30 hours	36 hours	36 hours
Bottle cap:					
Cover pouring lip	Yes††	.....	Yes	Yes††	
Prominent color	Black	Green	Red*	Blue	Red
Bottled in plant receiving only milk of this grade	.....	.....	Yes	Yes	.....
Plant approved by State Commissioner of Health	Yes	Yes	Certified-pasteurized Yes	Yes	.....
Supervision of medical milk commission	.....	.....	Yes	.....	.....
Monthly reports to Commissioner of Health	.....	.....	Yes	Yes	.....

*Certified milk pasteurized. Same as certified. Count after pasteurization not over 500. Words "Certified" in red and "Pasteurized" in black to appear on cap.

†Not permitted in cities or villages over 10,000 after July 1, 1937. Grade B regulations same as for Grade A, except cows need not be tested for Bang abortion disease, and printing on cap to be in brown.

‡750,000 if shipped by rail.

§Unless after repeated clean tests a longer interval is permitted.

‖Cows with mastitis and other diseases excluded.

¶When and if required by health officer.

**Specimens of excreta.

††Except upon recommendation of health officer approved by the State Commissioner of Health.

Source: The above tabulation was supplied by the State Department of Health, Albany, New York.

TABLE 76. Minimum Prices Established by New York Division of Milk Control for Payments to Producers for Milk Used for Various Purposes, New York State, 1935–36*

(Based on milk containing 3.5 per cent butterfat)

Month	Prices paid producers for milk utilized as–				
	Whole milk	Fluid cream	Condensed and evaporated milk	Butter	American cheese
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1935:					
January......	2.45†	1.55	1.59	1.22	1.17
February.....	2.45	1.55	1.71	1.31	1.30
March........	2.45	1.75	1.53	1.12	1.20
April.........	2.45	1.75	1.61	1.24	1.22
May..........	2.45	1.75	1.32	.94	1.08
June..........	2.45	1.75	1.21	.82	.99
July..........	2.45	1.75	1.22	.80	1.02
August.......	2.45	1.75	1.28	.85	1.11
September....	2.45	1.75	1.32	.90	1.12
October......	2.45	1.75	1.39	.98	1.15
November....	2.45	1.75‡	1.58	1.14	1.22
December....	2.45	1.80	1.68	1.22	1.40
1936:					
January......	2.45	1.80	1.68	1.24	1.29
February.....	2.45	1.80	1.71	1.34	1.18
March........	2.45	1.80	1.54	1.14	1.17
April.........	2.45	1.80	1.47	1.10	1.11
May..........	2.45	1.80§	1.38	.96	1.05
June..........	2.45	1.65	1.48	1.04	1.16
Average........	2.45	1.73	1.48	1.07	1.16

*Data supplied by the Division of Milk Control at Albany, New York.

†For areas with a retail price of less than 12 cents, the Class I price was $2.30 per 100 pounds.

‡From November 1 to 20, price was $1.75; from November 21 to 30, price was $1.80.

§From May 1 to 9, price was $1.80; from May 10 to 31, price was $1.65.

TABLE 77. SEASONAL VARIATION OF MILK PRODUCTION OF 90 PRODUCER-DISTRIBUTORS, 1935–36

Month	Jamestown	Central New York	Capital District	Long Island	All areas
	Quarts produced daily per distributor				
January	172	271	238	173	213
February	183	281	251	174	222
March	196	298	253	178	232
April	198	318	260	184	241
May	216	323	266	192	251
June	214	322	293	210	259
July	200	292	245	204	236
August	194	288	228	201	230
September	186	289	233	189	226
October	177	287	234	179	221
November	175	298	241	179	224
December	171	301	232	176	222
Average	190	297	248	187	231
	Index of average daily production				
January	91	91	96	93	92
February	96	95	101	93	96
March	103	100	102	95	100
April	104	107	105	99	104
May	114	109	107	103	109
June	113	108	118	113	112
July	105	98	99	109	102
August	102	97	92	108	99
September	98	97	94	101	98
October	93	97	95	96	95
November	92	100	97	96	97
December	90	101	94	94	96
Average	100	100	100	100	100

TABLE 78. INDICES OF SEASONAL VARIATION OF MILK PURCHASES BY 36 PRODUCER-DISTRIBUTORS, 1935–36
(Daily average for the year = 100)

Month	Jamestown area (11 distributors)	Central New York (9 distributors)	Capital District (8 distributors)	Long Island (8 distributors)	All areas (36 distributors)
January	123	136	114	89	121
February	144	131	86	91	114
March	151	114	99	89	117
April	109	88	105	88	102
May	109	96	119	97	110
June	84	84	96	81	89
July	75	86	119	155	99
August	77	87	114	147	98
September	76	94	83	118	85
October	76	99	84	82	85
November	91	100	87	69	91
December	87	85	93	94	89
Average	100	100	100	100	100

METHOD OF ALLOCATING COSTS TO RETAIL MILK

In order to determine the costs for the various products in the several sizes of containers, it was necessary to devise a means of allocating costs to each type of sale for each product. This was done by expressing all sales in units equal in cost of distribution to a quart bottle of retail milk. The cost per retail quart of milk was then obtained by dividing the total costs of operation by the total number of such units. The ratios used in converting the various items into retail quart units are given in table 79. In determining these ratios, each principal item of cost was broken down for each of the several operations in the plant and on the route. The ratios for allocating the cost of man labor in the plant were determined on the basis of the average time required for each plant operation such as pasteurizing, bottling, cooling, washing bottles and cans, boiler work, washing and cleaning equipment and floors. The relative time required in handling cream as compared with milk, and in handling the containers of different sizes, as compared with retail quart bottles, was determined for each operation. In operations prior to bottling,

TABLE 79. RATIOS USED TO COMPUTE QUARTS OF RETAIL MILK EQUIVALENT, INCLUDING THE VARIOUS PRODUCTS AND METHODS OF SALE, 92 PRODUCER-DISTRIBUTORS, 1935–36*

Product and method of sale	Cost classification				
	Plant	Container	Selling and delivery	Administrative	All costs
	Unit ratios per quart of milk sold				
Retail milk:					
Quarts	1.00	1.00	1.00	1.00	1.00
Pints	1.30	1.70	1.40	1.40	1.40
One-half pints	1.90	2.40	2.30	2.15	2.15
Wholesale milk:					
Quarts	1.00	1.00	0.50	0.70	0.70
Pints	1.30	1.70	0.70	1.00	1.00
One-half pints	1.90	2.40	1.15	1.50	1.50
Bulk	0.70	0.25	0.35	0.50	0.50
Milk sold at plant to other dealers:					
Quarts	1.00	1.00	....	0.45	0.45
Pints	1.30	1.70	....	0.65	0.65
One-half pints	1.90	2.40	....	0.95	0.95
Bulk	0.70	0.25	....	0.30	0.30
	Unit ratios per quart of cream sold				
Retail cream:					
Quarts	1.50†	1.00	1.00	1.20	1.20
Pints	1.95	1.70	1.40	1.65	1.65
One-half pints	2.85	2.40	2.30	2.50	2.50
Wholesale cream:					
Quarts	1.50	1.00	0.50	0.90	0.90
Pints	1.95	1.70	0.70	1.20	1.20
One-half pints	2.85	2.40	1.15	1.90	1.90
Bulk	1.00	0.25	0.35	0.60	0.60
Cream sold at plant to other dealers:					
Quarts	1.50	1.00	....	0.65	0.65
Pints	1.95	1.70	....	0.90	0.90
One-half pints	2.85	2.40	....	1.30	1.30
Bulk	1.00	0.25	....	0.40	0.40

*Ratios for by-products were as follows: chocolate milk and skimmilk same as retail milk; butter, 1.00 per pound for plant cost if made, 1.00 per pound each for selling and delivery cost and administrative cost; cottage cheese same as butter; eggs 1.00 per dozen for selling and delivery cost; all other by-products were given a selling and delivery ratio of 1.00 for each 25 cents of sales value.

†Plant ratios for cream were adjusted on a sliding scale according to the proportion of cream separated. Ratios for retail quarts of cream were 1.50 if 80 to 100 per cent of cream was made in the plant; 1.40 for 60 to 79 per cent; 1.30 for 40 to 59 per cent; 1.20 for 20 to 39 per cent; and 1.10 for less than 20 per cent made in the plant. The ratios for the other cream containers were reduced proportionately.

the ratio for labor was based on the volume of milk handled. Such operations were not affected by the size of the container to be used; neither were they changed if the sales were made at retail or at wholesale.

Labor used in washing bottles and in bottling milk was more nearly in proportion to the number of containers handled than to the volume of milk handled. It took almost as much labor to handle a half-pint as a quart bottle. Therefore, the ratio for labor for washing and filling four one-half pint bottles was nearly *four* compared to *one* for a quart bottle. The amount that this ratio was reduced below four represents the adjustment for ease in handling the smaller container. Weighted-average ratios for all plant labor were computed after the ratios for each item of labor were determined for the various sized containers and between milk and cream. These ratios per quart of milk handled were as follows: 1.0 for quart bottles; 1.5 for pint bottles; 2.5 for half-pint bottles; and 0.6 per quart of bulk milk sold in cans.

A similar procedure was followed in computing average ratios for use of equipment; use of buildings; heat, light, and power; and all other plant expense. The next step was to arrive at weighted-average ratios for all plant expense for the several-sized containers and for milk and cream. The ratios determined for each of the individual items of expense were given a weight based on the relative amount of total plant expense made up by each of the items. The resulting ratios for all plant expense are given in table 79.

The ratio for containers was obtained by developing separate ratios for bottles and cans, bottle caps, and bottle crates. The ratios for bottles and cans were based on the number of trips per container and on the initial cost. This cost was divided by the average number of trips made per container to obtain the average cost per trip. The resulting ratios for bottle and can costs per quart of milk or cream sold were found to be 1.00 for quart bottles, 2.25 for pint bottles, 3.50 for one-half pints, and 0.50 for bulk. A similar procedure was followed for bottle caps and bottle crates. A weighted-average ratio for all container costs was then obtained based on the separate ratios developed for bottles and cans, caps, and crates. These ratios are given in table 79 under container costs.

Ratios for selling and delivery costs were also the result of weighting the ratios obtained for each of the individual items of expense. Ratios for labor used in selling and delivering milk and cream were calculated for each operation in delivering milk. For example, the ratios for labor used en route between customers and to and from the plant were based jointly on space used and weight of milk handled in various types of containers. Since there was little difference between the ratios for weight and space, an average of the two was used as follows: 1.0 per quart in cases of 12 quarts or 20 pints; 1.2 for a quart of milk in a case of 30 one-half pints; and 0.5 per quart of bulk milk. Separate ratios were calculated for labor used in loading and checking out, for labor en route, preparation and waiting, and for labor serving customers. The weighted average of these ratios was 1.0 for quarts, 1.5 for pints, 2.6 for one-half pints, and 0.3 for bulk.

Ratios for truck and automobile expense were based upon the ratio developed for time serving customers, or 1.0 per package handled and 0.5 per quart of bulk goods. All expense for delivery and selling, other than truck, automobile, and labor expense, was based on the volume of product handled and was 1.0 for all types of containers. In calculating the final ratios for all selling and delivery costs, labor was given a weighting of 50 per cent, truck and automobile, 32 per cent, and all other, 18 per cent. The resulting ratios are given in table 79 under selling and delivery.

The ratios for wholesale sales were found to be approximately one-half those of retail sales.

Administrative costs were allocated by developing ratios based on the weighted average of the ratios developed for plant costs, container costs, and selling and delivery costs. These administrative ratios are given in table 79.

In computing total quarts of retail milk equivalent, the total quarts of products sold in each type of container for each type of sale were multiplied by the ratios in table 79. This resulted in calculating different volumes of equivalent retail quarts for each of the cost classifications given in table 79. Costs per quart were then calculated on the basis of these volumes.

An example showing the computation of total quarts of retail milk equivalent used in determining the selling and delivery costs per retail quart of milk equivalent is given below:

150 quarts of milk retailed a day in quart bottles (ratio is 1.0) = 150 units
20 quarts of milk retailed a day in pint bottles (ratio is 1.4) = 28 units
50 quarts of milk wholesaled in quart bottles (ratio is 0.5) = 25 units
10 quarts of cream retailed in ½-pint bottles (ratio is 2.3) = 23 units

Total quarts of retail milk equivalent, daily = 226
Selling and delivery cost per day = \$6.78
Average selling and delivery cost per quart 6.78 ÷ 226 = 3.0 cents

Similar calculations were made for each of the cost classifications. These average costs were then added to obtain total costs per quart.

If a distributor does not care to break down his costs into plant, container, selling and delivery, and administrative, he might determine the total costs per quart by merely using the ratios for total costs given in table 79 to determine total quarts of retail milk equivalent. This figure divided into the estimated daily cost for all operations will give the approximate cost of selling a quart of retail milk.

TABLE 80. AVERAGE YEARLY FARM AND MILK DISTRIBUTION EXPENSES OF 81 PRODUCER-DISTRIBUTORS, 1935–36

Item of expense	Jamestown	Central New York	Capital District	Long Island	All areas
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Milk, cream, and by-products	1,606	1,547	4,784	823	1,903
Livestock	547	1,154	860	741	847
Hired labor	947	2,898	2,812	1,784	2,103
Unpaid labor	885	331	232	580	520
Truck and automobile	590	989	946	732	815
Milk-room equipment	28	269	271	200	190
Milk-room supplies	232	331	415	301	312
Containers	308	378	336	266	326
Inventory decrease	155	117	121	102	124
Building repairs amd new buildings	529	707	754	312	571
Wood	2	11	7	...	5
Insurance	79	142	99	60	99
Freight and storage	47	10	9	7	19
Machinery and equipment	191	359	403	48	245
Gasoline and oil for farm use	61	119	131	17	81
Dairy supplies	26	52	23	26	34
Veterinary, medicines, and disinfectants	27	113	56	76	72
Fences, drains	27	25	54	14	27
Cattle feed	983	1,641	1,380	1,715	1,447
Other feed	95	165	329	1,461	493
Stock pasturage	19	22	15	35	23
Feed grinding	9	9	3	...	6
Fertilizer and lime	106	90	112	57	89
Horseshoeing	19	22	29	8	19
Seeds, plants, sprays	64	145	127	13	89
Taxes	126	229	208	335	225
Stamps and stationery	3	12	11	10	9
Telephone	26	60	35	55	46
Water rent	...	12	41	32	18
Electricity	138	212	231	151	181
Packages	3	2	3	...	2
Publicity	55	99	65	49	70
Collection losses	226	312	362	251	283
Licenses, M. C. B. and dealers	29	34	28	25	30
Hired bottling and pasteurizing	116	...	...	8	32
Land rent	51	73	27	118	71
All other	14	452	83	19	172
Total expenses	8,369	13,143	15,402	10,431	11,598

TABLE 81. PRODUCTIVE-MAN-WORK UNITS FOR LIVESTOCK, CROPS, AND OTHER FARM ENTERPRISES IN NEW YORK

Kind of enterprise	Work units per head	Kind of enterprise	Work units per acre
Livestock		Crops	
Cattle:		Corn for silage	3.5
Cows	15.0	Corn for fodder	3.0
Heifers, bulls	2.0	Corn for grain	6.0
		Small grain threshed	1.5
Poultry:		Small grain cut for hay	1.5
Hens, per 100 birds	20.0	Hay for cutting	1.0
Pullets raised, per 100 birds	5.0	Potatoes	8.0
		Cabbage	9.0
Hogs:		Beans, field	3.5
Brood sows	3.0	Peas, canning	2.0
Other hogs	0.5	Apples	9.0
		Non-bearing orchard	2.0
Sheep:			
Ewes and bucks	0.5		
Lambs fattened	0.15		
Miscellaneous			
Retail milk:			
Per quart of milk equivalent sold daily	1.8		
Custom pasteurizing, bottling, bottle-washing per quart of milk equivalent daily	0.9		
Maple sirup, per 100 gallons	19.0		
Work off farm, per day	1.0		

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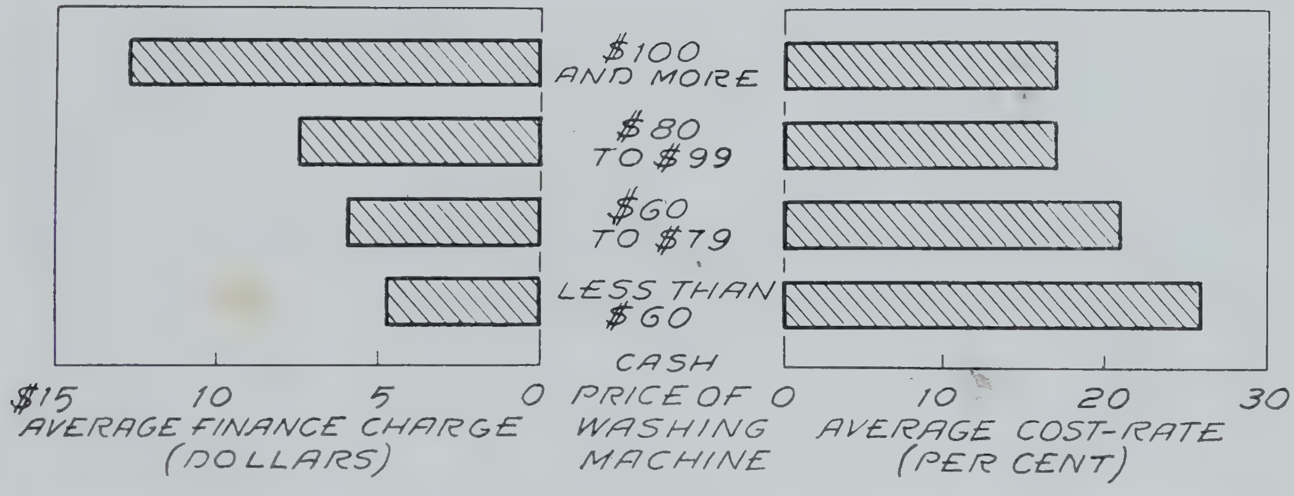
Installment Credit in the Sale of Washing Machines

Mabel A. Rollins



CASH PRICE OF WASHING MACHINES PURCHASED, AND CHARGE FOR INSTALLMENT PRIVILEGE IN DOLLARS AND AS A RATE

Although the dollar charge for installment credit was higher on the higher-priced machines, the annual rate was lower

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INSTALLMENT CREDIT IN THE SALE OF WASHING MACHINES

Mabel A. Rollins

Since consumer credit is used by many persons today, it should be understood as fully as possible. Consumer credit has been defined as credit granted for consumption with no expectation that direct monetary profit will arise from its use. While this bulletin relates to only one aspect of the problem, a brief discussion of the broader field may help to place the findings here presented in their proper perspective.

The subject of consumer credit has been widely discussed and debated. Some persons have held that it is beneficial to consumers in that it enables those with low incomes to purchase goods that would not otherwise be available to them; that it makes goods available to consumers when needed instead of their use being postponed until sufficient money is saved to buy them; that those who never could or would save the money to make the purchase outright can and will pay for articles that they have already purchased. In this way, it is argued, people with low incomes may acquire articles of greater utility than they might purchase if they bought only what their available cash would permit. Furthermore, it is said that articles of a high unit value, such as automobiles, refrigerators, and washing machines, thus become available for mass distribution, a process that is essential if advantage is to be taken of savings by mass production.

On the other hand, persons who feel that consumer credit has brought more harm than good, say that the unwary are induced to purchase articles not needed or wanted, because the initial step is so easy—the down-payment is small and the contract is signed and the purchaser bound by it before he realizes what he has done. Further, it is pointed out that such purchasers are too inexperienced to know what their legal rights are and may be easily exploited by the unscrupulous. It is said also that the charge for this type of credit is high and is levied on the class of people least able to afford it.

These and many other arguments are brought up by each side. Some are unproved, others unprovable, and a large number are not supported by sufficient data, although an increasing body of factual information is becoming available. The study[1] upon which this bulletin is based was undertaken by the Department of Economics of the Household and Household Management of the New York State College of Home Economics, in an effort to add to the body of facts now available to the public.

There are two forms in which credit for consumers may be obtained, in money or in goods. For the former, there are several sources, such as personal-loan departments of commercial banks, industrial banks, credit unions, small-loan companies, and pawn shops. For credit in goods there is only one source, the retail store. This latter type of credit may be granted in two forms, however, either as open credit or as installment credit. Credit in goods is more widely used than is credit in money (table

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[1] Reported in a thesis entitled *Some Store Practices in the Sale of Washing Machines on Installment Credit*, by Mabel A. Rollins; this was presented to the Faculty of the Graduate School of Cornell University, February, 1940, in partial fulfillment of the requirements for the degree of doctor of philosophy.

1). These two forms cannot be wholly separated, however, because consumers frequently borrow money in order to make purchases of goods.

TABLE 1. SOME AGENCIES ENGAGED IN GRANTING CREDIT TO CONSUMERS

Credit agencies	Kind of security generally obtained	Amount outstanding (millions)		Per cent of total		Range in usual charges‡ (per cent)
		1936*	1935†	1936*	1935†	
Personal-loan departments of banks	Marketable security for collateral Co-maker	$ 129	$ 40	2	1	6–23
Industrial banks	Co-maker	234	110	5	2	12–34
Credit unions	Knowledge of borrower	55	40	1	1	8–18
Small-loan companies	Chattel mortgage	285	225	6	4	30–42
Pawn shops	Article deposited	110	110	2	2	24–120
Retail stores:						
Open credit accounts	Credit standing of purchaser	1,500	2,800	30	46	§
Installment credit	Article purchased	2,600	2,100	51	34	0–500
Other‖	....	153	645	3	10	......
Total	....	$5,066	$6,075	100	100	......

*Grobben, M. Volume and classification of consumer loans. Amer. Acad. of Polit. and Soc. Sci. Annals **196:** 74. 1938.

†[Anon.] Credit for consumers. Public affairs pamphlet 5:21. 1936.

‡[Anon.] Credit for consumers. Public affairs pamphlet 5:22. 1936.

§It is generally assumed that the charge is included in the mark-up.

‖Includes remedial loans, illegal loans, special loans, commercial-bank personal loans not segregated.

For those who wish to read further on this subject the following bibliography, from which selections may be made, is suggested:

WILDER, E. (compiler). Consumer credit bibliography, p. 1–142, 1938. In addition, readings on particular subjects are suggested at the end of each section.

It is always advisable for those who are contemplating the use of installment credit to investigate not only the cost of this type of credit at more than one store but also the cost if the money were borrowed and cash paid for the article.

The study here reported considered one aspect of credit in goods, that of installment credit, with special reference to the sales of washing machines. This particular commodity was chosen because it is one in which many homemakers are interested and because a high proportion of the sales are made on installment credit. The information was collected through personal interviews with merchants or credit men in 290 stores selling washing machines in New York State towns and villages during 1938. The part of the study concerning the terms on which the washing machines were sold, the prices of the machines, the down-payments, the finance charges, and the like, is based on 310 contracts that the merchants were asked to select as typical of the sales on installment credit that had been made in their stores during the preceding year. This method of course allowed the merchant to select those contracts that presented his terms in the most favorable light, if he wished to do so, and the stores whose practices were questionable may have been among those that refused to contribute information, since participation in the study was voluntary; however, it had the advantage of supplying information on actual installment sales.

EXTENT OF INSTALLMENT SALES OF WASHING MACHINES

The majority of washing machines are sold on installment credit, it is usually agreed. In this study, 266 stores from which usable records were obtained made approximately 80 per cent of their sales in this fashion. This percentage was about the same as that estimated by E. R. A. Seligman in 1927.

That the percentage has not changed since that time is not in conflict with the statement often made that installment sales are increasing, because the sales of certain articles, including washing machines, have increased in volume, and, therefore, the number of washing machines sold on installment credit has increased, even though the proportion of sales in this fashion has not changed. Installment sales probably reached their highest percentage to date in 1929, when it was estimated that they represented about 13 per cent of all retail sales.

During periods of increasing sales, such as 1935 and 1936, installment sales seemed to increase more rapidly than did other sales; the reverse, however, appeared to be true during periods when all sales were decreasing, as in 1938, for then installment-credit sales decreased faster than did all sales (table 2).

TABLE 2. PERCENTAGE CHANGE IN INSTALLMENT SALES AND TOTAL SALES, 1934–38*

Years	Percentage change	
	Installment sales	Total sales
1934 to 1935	+19.0	+ 7.8
1935 to 1936	+24.7	+14.9
1936 to 1937	+ 3.1	+ 5.2
1937 to 1938	−28.5	−11.3

*Adapted from LaCrosse (1936:1) and Merriam (1939:7).

Such changes might be expected. While in times of depression some persons may stop their purchases for cash because they wish to keep a reserve against emergencies, the merchant himself may stop some possible installment sales because he, rather than the purchaser, is pessimistic about the ability of the buyer to repay. For instance, in one locality where a strike in the principal industry of the town was threatened, the merchants said that they were making no installment sales of washing machines until the labor difficulty had been cleared up. They also added that they were making practically no sales in any form. The workers were receiving their wages and were willing to make purchases; but there were sales only for cash, and most persons purchase a washing machine only if granted credit.

Stores in small localities tended to sell a slightly smaller percentage of their washing machines on installment credit than did stores located in centers of large population (table 3). In small towns it may have been felt that there was less need of the protective type of credit represented by the installment contract, and, therefore, more use could be made of open credit. It may also have been true that the residents of the smaller centers were less inclined to purchase goods on an installment

TABLE 3. PERCENTAGE OF WASHING MACHINES SOLD ON INSTALLMENT CREDIT, ACCORDING TO SIZE OF TOWN
(266 stores, New York State, 1937–38)

Population	Number of stores	Per cent of washing machines sold on installment credit
Less than 4,950	59	76
4,950 to 19,949	76	81
19,950 to 49,949	56	82
49,950 and more	75	85
All stores	266	83

basis; or they may have been more conservative; or they may have received their income in a form that inclined them less to purchase on installment credit; or they may have preferred to buy in a larger town where the selection was greater, or where it would not be known to their neighbors that they were using this form of credit. Several merchants remarked during the interview that they frequently had inquiries from stores in larger cities about the credit standing of their customers who were making installment purchases in these larger cities. On the other hand, the fact that a piece of equipment such as a washing machine frequently needs to be serviced, might lead the customer to make the purchase near home. But the most significant fact was that in all sizes of localities, the majority of washing machines were sold on installment credit.

The kind of store seemed to make no great difference in the proportion of washing machines sold on installment credit. Although some kinds of stores made a high percentage of their total sales on installment credit and others a low percentage, according to the findings of the Retail Credit Survey (table 4), all kinds of stores made approximately the same proportion of their washing-machine sales on installment credit.

TABLE 4. PERCENTAGE OF THE TOTAL SALES IN MIDDLE ATLANTIC STATES AND OF SALES OF WASHING MACHINES IN NEW YORK STATE, MADE ON INSTALLMENT CREDIT, ACCORDING TO KIND OF STORE, 1938

Kind of store	Middle Atlantic States*		New York State†	
	Number of stores	Per cent of total sales made on installment credit	Number of stores	Per cent of washing-machine sales made on installment credit
Department	38	10.3	27	85
Furniture	23	83.9	49	89
Hardware	25	1.2	43	80
Household appliance	7	64.6	129	79

*Adapted from Merriam (1939: 58, 74, 97, 111).
†Present study.

For those who wish to study further the extent of sales on installment credit, the following references are suggested:

MERRIAM, M. L. Retail credit survey, 1938. U. S. Commerce Dept., Domestic commerce ser. **109**: 3–179. 1939.

SELIGMAN, E. R. A. Economics of instalment selling. **1**: 92–119. 1927.

HOW INSTALLMENT SALES OF WASHING MACHINES ARE FINANCED

While it was stated earlier that there is only one source for credit in goods for consumers, retail stores, indirectly there are sometimes several agencies participating in this type of financing, because in an installment sale the seller does not receive complete payment for the article thus sold for some time; there is, therefore, the problem of financing this sale. The store itself may carry the contracts either out of its own cash resources or by obtaining a loan from a commercial bank under an established line of credit. In such a case, in a particular sale, only two contracting parties are involved either directly or indirectly, the buyer of the article and the seller. All subsequent arrangements will also involve only these two.

However, the store sometimes cannot afford to keep its capital tied up in negotiable paper, and does not have an established line of credit with a bank. It must then discount its installment paper with, or sell it to, a third party. Under such circumstances, three parties are involved in a particular transaction, the buyer, the seller, and the party taking the paper. Since the seller may have no other way of financing the sale, except with the aid of a third party, he will consult or follow the advice of the third party concerning acceptable buyers, at the beginning of the transaction. The third party may take an active part in the investigation of the credit standing of the customer and in the collection policy followed.

The dealer who carries his own installment contracts is in a position to make individual arrangements with his customers. He might be somewhat inclined to be lenient in these arrangements, since the particular transaction involved might be considered merely as one purchase in the total purchases of the customer. And expectations of future business might play an important part in his calculations. However, a third party, handling the contract, would probably be more interested in the particular transaction and less interested in the future purchases of the customer.

Of the agencies dealing in installment contracts, the finance companies handle the largest proportion. The history and functions of this type of agency have probably been most adequately described by Seligman.

Banks have entered into this type of business to some small extent in competition with the finance companies. In this study, two other agencies were also found to be dealing in installment contracts. One of these was a public-utility company. Such companies have been interested to a large extent in the sale of electric current, and the sale of electrical appliances increases the sale of such current. The utility companies have sometimes been inclined to be more anxious to place the electrical equipment in use than to make the most profitable sale. For this reason, they have occasionally extended terms considered too long and too lax by other sellers. On the other hand, the utility companies sometimes have felt that dealers were not pushing the sale of electrical equipment sufficiently. Therefore some conflict of interest has existed between these two groups. The action of one public-utility company in handling dealers' installment paper, as found in this study, may be an effort to prevent such conflict. The other case was of two merchants visited during this study who reported that some individual whom they preferred not to mention was discounting their contracts.

It was found that not only did several different agencies finance the sales of washing machines on installment credit, but that the same store might use several of these agencies. Various reasons were given for the use of two or more agencies. Some merchants said that they carried the contracts of their very good customers themselves. They wished to be in a position to treat these people as well as possible, sometimes making the finance charge less than that which would have been necessary if the contract had been carried by a finance company. Some merchants carried the accounts of customers who refused to purchase if the contract was to be handled by a finance company. One merchant said that he carried the contracts of those customers for whom he could not get a credit report satisfactory to the finance company, but whom he knew to be good risks. Several stores turned over to a finance company contracts of those customers with whom they had experienced difficulty in the past in regard to collections; these people, they said, would take advantage of the store but would make prompt payments to the finance company. Some stores carried all the contracts that they could, and then, when pressed for cash, turned some of them over to the finance company.

When the public-utility company financed the contracts, in some cases it was necessary for the store either to carry some of the contracts or to sell them elsewhere; the utility company handled only the contracts of those who were users of the utility company's service and had paid their bills satisfactorily for at least two years.

Merchants who used the facilities of both a bank and a finance company said that they sometimes found that they could finance contracts refused by the local bank, through a finance company. Also, the finance company sometimes gave more help in collecting accounts than did the bank.

The store itself did most of the financing. Fifty-two per cent of the value of the contracts was financed by the store alone, while only 13 per cent of the value of the contracts was handled by the finance company alone (table 5). Sixty-eight per cent of the stores financed at

TABLE 5. NUMBER OF STORES AND VALUE OF CONTRACTS, ACCORDING TO VARIOUS FINANCING AGENCIES USED
(266 stores, New York State, 1937–38)

Agency used	Number of stores		Value of contracts		Per cent of stores		Per cent of total value of contracts	
One agency:		178		$1,063,890		67		68
Store	98		$816,240		37		52	
Finance company	61		208,450		23		13	
Bank	12		24,080		4		2	
Other*	7		15,120		3		1	
Two agencies:		80		447,090		30		28
Store and finance company	57		314,260		22		20	
Store and other agency	17		113,280		6		7	
Finance company and other agency	6		19,550		2		1	
Three agencies:		8		53,670		3		4
Store and two other agencies	8		53,670		3		4	
Total		266		$1,564,650		100		100

*Public-utility company or other individual.

least some of their sales of washing machines themselves, and 62 per cent of the value of the contracts was handled by the store (table 6). The finance company was an agency used by 50 per cent of the stores, but only 29 per cent of the value of the contracts was handled by the finance company.

TABLE 6. PERCENTAGE OF STORES USING VARIOUS AGENCIES FOR FINANCING INSTALLMENT SALES OF WASHING MACHINES, AND VALUE OF CONTRACTS FINANCED BY THESE AGENCIES
(266 stores, New York State, 1937–38)

Financing agency	Per cent of stores*	Value of contracts	Per cent of total value of contracts
Store, total:	68	$ 972,840	62
Store alone	37	$816,240	52
Store and one other agency	28	147,350	9
Store and two other agencies	3	9,250	1
Finance company, total:	50	457,380	29
Finance company alone	23	208,450	13
Finance company and one other agency	24	218,760	14
Finance company and two other agencies	3	30,170	2
Bank, total:	15	114,650	8
Bank alone	4	24,080	2
Bank and one other agency	8	76,580	5
Bank and two other agencies	3	13,990	1
All other agencies	4	19,780	1
Total	....	$1,564,650	100

*No total can be stated since 80 stores financed their contracts through two agencies, and 8 stores financed their contracts through three agencies.

While the finance company handled only about one-fourth of the washing-machine installment contracts, it was participating in the financing done by one-half of the stores. Several merchants stated that they contemplated turning over to the finance company some of the contracts that they were handling themselves. It is therefore probable that the policies of the finance companies have wider influence than would be indicated by the actual amount of the contracts financed by them.

The stores located in the large cities handled a much larger percentage of the value of their contracts themselves than did the stores in the small localities, and the stores in the small localities financed a much larger percentage of their contracts through the finance companies than did the stores in the large cities (table 7).

TABLE 7. VALUE OF CONTRACTS, ACCORDING TO SIZE OF TOWN AND FINANCING AGENCY
(266 stores, New York State, 1937–38)

Population	Value of contracts financed by—				Per cent			
	Store	Finance company	Other agencies	All agencies	Store	Finance company	Other agencies	All agencies
Less than 4,950	$ 32,880	$ 50,350	$ 29,310	$ 112,540	29	45	26	100
4,950 to 19,949	148,850	103,690	31,320	283,860	52	36	12	100
19,950 to 49,949	224,090	159,170	14,610	397,870	56	40	4	100
49,950 and over	567,020	144,170	59,190	770,380	73	19	8	100
All stores	$972,840	$457,380	$134,430	$1,564,650	62	29	9	100

If more information is desired concerning agencies financing installment sales some helpful material may be found in:

[ANON.] Methods of financing installment sales of farm equipment, p. 1–18. Metropolitan Life Insurance Co., Policyholders Service Bur. 1935.

AYRES, M. V. The economic function of the sales finance company. Amer. Statis. Assoc. Journ. **33**: 59–70. 1938.

PLUMMER, L. A defense of automobile financing by banks. Time-sales financing **4**[4]: 7–8. 1939.

SELIGMAN, E. R. A. Economics of instalment selling, **1**: 33–91. 1927.

HOW THE CHARGE FOR INSTALLMENT CREDIT MAY BE STATED

One of the most confusing aspects of credit in goods is the difficulty of determining how much is being charged for the service. This is not limited merely to installment credit but is also true of open credit accounts. Some stores that say they do not make a charge for goods purchased on open account sometimes give a discount for cash. When the store does not make any difference between the cash and the credit price, the cash customer contributes toward the payment of the credit cost. Credit is a service; in some way the store that stays in business has to meet this cost just as it does its rent and payroll expense, and this cost must be reflected in the prices it receives for its goods.

While the charge for credit is usually not clearly expressed in open credit or charge accounts, it seems to be even more confusing in the purchase of goods on installment credit. There are two ways in which this charge can be confusing: in the method by which the price of the article is stated to the customer, and in the way in which the charge itself is quoted. In the study of washing machines, four ways were found in which the merchant quoted the price to a customer who was buying the machine on installment credit (table 8). He might tell the customer (1) what the price would be for cash; to which an extra amount would be added when the customer made his arrangements for an installment purchase; or (2) what the price would be if the article were bought on installment credit, in which case an amount might or might not be deducted if the customer paid cash; or (3) he might tell both the price

TABLE 8. METHODS USED BY STORES IN QUOTING THE PRICE FOR WASHING MACHINES SOLD ON INSTALLMENT CREDIT

(26,946 washing machines sold by 266 stores, New York State, 1937–38)

Method of quoting the price	Per cent of—	
	Stores	Washing machines sold
Cash price, with finance charge to be added	80	73
Installment price	9	10
Installment and cash price	5	9
List price*	6	8
Total	100	100

*In these cases a price was quoted; then, if the purchase were made on an installment basis, an additional amount was added to the quoted price, but a discount from this quoted price was given if the customer paid cash.

for a cash purchase and the price for an installment purchase; or (4) he might quote a list price to which was added an amount if the customer purchased on an installment plan or from which an amount was subtracted if the customer paid cash.

Actual examples of these four methods used by merchants in quoting the price were: (1) a machine was quoted at a cash price of $69.98 to which a finance charge was added, either in the form of a flat dollar charge, a specified number of periodic payments, or a percentage per year of the balance; (2) a machine was quoted at an installment price of $77.50; (3) a machine was quoted at a cash price of $79.95 and an installment price of $86.45; (4) a machine was quoted at a list price of $49.95 to which a finance charge of $5 was added, or from which a discount of 10 per cent was allowed if the customer paid cash.

Unlike the findings from some of the other studies that have been made, in this study a cash price was found to be most frequently quoted. It appears that nationally advertised articles, such as washing machines, whose prices may be fairly readily compared from store to store, are more likely to be quoted at a cash price to which a charge is added, than at an installment price from which a deduction may or may not be made if the customer pays cash. The cash price is the lower price, and the lower price is the best one for the merchant to quote when comparisons are possible. In the case of such articles as furniture where great and not easily detected differences in quality may exist, the price quoted is quite likely to be the installment one.

In addition to various ways of quoting the price, there are several different ways in which the charge for credit may be quoted. In this study, six different methods were found to be used, and some stores used two or more of these methods (table 9). Three of these methods accounted for about three-fourths of the sales; these were, the flat dollar charge, the percentage per year of the original unpaid balance, and the payment schedule. Two examples of the flat-dollar method of stating the charge were (1) that of a merchant who quoted a $7 charge on all $69.98 machines, and (2) that of a merchant who charged $5 for both a $79.50 washing machine and a $59.50 washing machine; the second method was illustrated by a merchant who quoted a cash price of $110, down-payment of $10, and a charge of 6 per cent per year of the original

TABLE 9. METHODS OF QUOTING THE CHARGE FOR INSTALLMENT CREDIT
(26,946 washing machines sold by 266 stores, New York State, 1937–38)

Method of quoting the charge	Per cent of—	
	Stores	Washing machines sold
No charge	2	1
Discount for cash	7	9
Discount for cash and other charge	6	8
Flat dollar charge	15	21
Percentage per year of the original unpaid balance after making down-payment	22	28
Payment-schedule charge	37	23
Percentage per year of the decreasing unpaid balance after making down-payment	2	2
Two or more methods	9	8
Total	100	100

unpaid balance, or $6; and an example of a payment schedule was a contract for $79.88, down-payment of $5, and 16 monthly installments of $4.68 each. The second of these three methods, was used by somewhat more stores than was the first, but it was not used by as many stores as was the third.

FLAT DOLLAR CHARGE

The flat dollar charge for credit is perhaps the simplest method for the merchant, but it is not so satisfactory for the customer, unless a much higher degree of standardization in installment selling practices than now exists is to be considered desirable. When such a charge is made, one of two policies may be followed. Either every customer purchasing a washing machine of a given price is expected to make the same down-payment and to complete the payments in the same length of time, the finance charge therefore being the same for all purchases at this price; or the merchant charges the same amount to all installment purchasers, regardless of the size of their down-payments, the price of the article purchased, or the length of time taken to pay for the article. According to the information presented later from this study, it appears that there is a good deal of variation in the amount of the initial payment that customers make, even when the price of the washing machine is the same; that is, that uniform payments at the beginning of the transaction are not now the customary procedure. When a flat dollar charge is made, the purchaser is not offered an inducement to complete his contract quickly, since fast and slow payers are charged the same amount.

PERCENTAGE PER YEAR OF THE UNPAID BALANCE

The method of expressing the credit charge as the percentage per year of the unpaid balance has been advocated by many merchants partly because it emphasizes to the customer the advantages of a larger down-payment and a shorter contract. If the customer knows that the size of the down-payment determines the balance on which the carrying charge is calculated, and that, therefore, the larger the down-payment, the smaller the carrying charge, and if he also sees that the sooner the payments are completed the smaller the carrying charge, he is more likely to make the largest possible down-payment and the periodic payments as few in number as possible. Certainly this method of quoting the charge helps to make this aspect of the situation clear for the buyer. It also shows what the allowance will be if payment is made ahead of the termination of the contract. None of the other methods of quoting the charge do this, and a variety of different allowances are made. It also makes clear what the charge will be if payments are not completed within the allotted time.

It has one possible disadvantage for the store, however. It is generally used for all types of sales, and a constant rate may not yield sufficient revenue on small purchases running for a short time to cover the cost of granting such credit, but may yield more than enough on the larger purchases. Stores have not fully analyzed their costs for the granting of credit and they do not know the extent of their installment sales of high-priced, long-term goods bringing sufficient revenue to cover the costs, and of low-priced, short-term goods that do not bring in sufficient revenue; this, however, is one aspect of the problem that is being given serious consideration at present.

Furthermore, this method has a rather serious disadvantage for the customer. The customer is likely to confuse a percentage per year on the original unpaid balance with an ordinary interest rate. Such an expression of the rate thus implies to the customer that the cost of the purchase on installment credit is much lower than is actually true. The customer who is comparing the cost of borrowing the money and paying cash for the purçhase and the cost of purchasing on installment credit may be misled by this method of quoting the charge for an installment purchase. Even though there may be no intention to deceive in the mind of the merchants who use this method, it may, nevertheless, have this effect.

PAYMENT SCHEDULE

It was found in this study that the payment schedule was used by most stores that sold their paper to a finance company because the finance companies provided these schedules and wished the contracts that they bought to comply with these conditions. When these payment schedules are used, the allowance for the trade-in and the cash down-payment are subtracted from the quoted price (not always the lowest cash price that can be obtained, as previously pointed out, page 11, in those cases where a discount for cash is given); the amount thus obtained is "the balance". The monthly payments that the customer must make and the total amount of his payments, including the finance charge, may then be read from a table of calculations based on the amount of the balance and the length of time the customer wishes to take to pay the contract. The customer may not learn the amount he is paying for the credit privilege without a specific question on this point, especially if the seller tells him only the amount of each monthly payment and not the total amount. Both are usually entered on the installment contract, but since several merchants reported in this study that they had encountered difficulties with customers who had signed contracts and then found out that the amount remaining to be paid after they had made their down-payment, was greater than the cash price of the washing machine, it would appear that this point was not stressed sufficiently at the time of the sale. It was said that sometimes the salesman, in his eagerness to make the sale, failed to make clear to the customer the size of "the balance" plus the finance charge, and the difference between the cash price and the installment price. The fact that these payment schedules are usually in the salesman's hands and are not easily available to the customer for inspection may mean that the customer does not arrange his payments in the best possible fashion. When payment schedules are used, it is the salesman's responsibility to see that the customer makes the largest possible down-payment and pays the contract in the shortest possible time. If the customer does not see the advantage of such a procedure he may not be as cooperative as he would be otherwise. There was considerable comment from the merchants reporting in this study, to the effect that the salesmen in their anxiety to make the sale did not obtain as large a down-payment or as short a contract, as would have been possible.

Unfortunately the payment schedule does not provide any way of calculating the amount to be refunded if the contract is paid ahead of the due date.

The fact that the financing of the contracts has been done by many different agencies under different circumstances would account in part for the high degree of variation in the methods of stating the charge. As has been pointed out, not only did many stores with their own individual problems carry a large part of the contracts themselves, but several outside agencies, such as finance companies and banks, also participated in the financing. These all have their own ideas as to the methods that should be used. While the variety of the financing agencies through competition with each other has probably led to lower charges, it has also made the problem of standardization in the method of making the charge more difficult.

Since customers do not, as a general rule, make a standardized downpayment or complete their payments in the same length of time, the methods of expressing the charge should allow for these variations. Only two of the methods used by stores visited in this study meet this requirement: the percentage per month of the unpaid balance, and the payment schedule. The objection to the former is fundamental: since it has a tendency to cause the charge to appear low, it may be misleading when comparisons are made with charges made by other agencies of consumer credit that base their percentage rate not on the original unpaid balance but on the decreasing unpaid balance. The objections to the payment schedule are more capable of adjustment: the additional amount charged for the installment purchase needs to be more clearly presented, no calculations should be necessary to arrive at this figure, and these schedules should be more easily available to the customer for inspection and consideration. The refund to be given if the payments are completed before the due date should also be clearly stated.

PERCENTAGE PER YEAR OF THE DECREASING UNPAID BALANCE

No store visited in the study here reported was quoting the charge as a percentage per month or per year of the decreasing unpaid balance. The advantages of this method from the customer's point of view, as summarized by the Committee on Consumer Credit of the Commonwealth of Massachusetts, are quoted as follows:

1. Whenever goods are sold on deferred payment, the seller performs two separate functions; the sale of merchandise and the extension of credit for which a charge is made.
2. Whenever a charge is made for the extension of credit, this charge should be stated in terms which make it readily comparable with all other prices for the use-of-money repayable in monthly instalments.
3. The only accurate way to express the price of the use-of-money is by a given percentage on a given principal for a given time. Any other method of statement permits juggling with one of the two variables, principal and time.
4. In instalment credit, the outstanding amount of credit declines from month to month. Therefore the only accurate and outspoken way to express the charge for this type of credit is in terms of a given percentage on the current, unpaid monthly balance. (Report of Committee on Consumer Credit, 1936, page 25, footnote.)

To make such a quotation of the charge satisfactory for the purchaser, however, the amount of the additional charge for installment credit in dollars and cents should also be given. As will be shown later, the charge expressed in this manner is lower for the higher-priced washing machines (table 14, page 20), for which the contract runs for a longer period of time (table 17, page 22). The charge in dollars and cents in both these cases is higher, however. The purchaser who did not also know the charge in dollars and cents might thus be misled.

The chief objections to the use of the percentage per month of the decreasing unpaid balance method of quoting the charge from the merchant's point of view have been that such a quotation meant a percentage rate per year that was fairly high, and that the customer has been more interested in the dollar-and-cent cost than in the interest rate. It is certainly true that the average customer regards any interest rate above 6 or 8 per cent as exorbitant, and does not take into account the fact that costs of granting credit may differ. Even if the customer is more interested in the dollar-and-cent cost, as these merchants say, up to the present the cost has quite frequently not been presented in that manner.

If further study of this question is desired the following titles are suggested:

[ANONYMOUS] Pricing retail instalment sales with or without the carrying charge, p. 1–19. Metropolitan Life Insurance Co., Policyholders Service Bur. 1933.

COMMITTEE ON CONSUMER CREDIT (Massachusetts). Rept., p. 6–86. 1936.

INSTALLMENT CREDIT TERMS ON WHICH WASHING MACHINES ARE SOLD

In addition to supplying information concerning general practices in the sale of washing machines on installment credit, each merchant visited during this study was asked to select a contract for the sale of a washing machine on installment credit made to a customer and considered representative of such sales made by that store. The details of the sale were recorded and also any information that could be supplied concerning the purchaser. The following paragraphs are based on these contracts.

The average cash price of the washing machines purchased on these installment contracts was $77. This average was not very different from the $73.39 reported by *Business Week* as the average price of washing machines sold at retail (Anon., 1938: 31).

The average amount of the total initial payment made, when the customer bought the machine, or the amount that could be considered the customer's "equity" in the washing machine at the time of purchase, was $11. This item was the most variable of all terms of the contracts. This payment could be made in three ways: as a cash payment, the most common method used; as an allowance that the store gave on an old machine; or as a combination of both. Of the 310 persons who purchased washing machines, only 12 made no payment at all at the beginning of the transaction (table 10). The initial cash payment was, on the average, $9. Only 66 persons received a trade-in allowance, and of these only 27 made no payment in cash at the beginning of the purchase. The average amount received as an allowance by those persons who turned in their old ma-

TABLE 10. METHODS USED BY CUSTOMERS IN MAKING THE INITIAL PAYMENT FOR WASHING MACHINES SOLD ON INSTALLMENT CREDIT

(310 installment contracts for washing machines from 284 stores, New York State, 1937–38)

Method of making initial payment	Number of contracts
Cash down-payment only	232
Trade-in allowance only	27
Cash down-payment and trade-in allowance	39
No initial payment	12
Total	310

chines was $12. The payment made at the beginning of the transaction represented 15 per cent of the cash price, on the average: the cash down-payment was 12 per cent, and the trade-in allowance 3 per cent, of the cash price.

Three intervals during which payments could be made were found in this study. The majority of the purchasers, more than 80 per cent, made their payments monthly; about 15 per cent made their payments every week, and only 2 persons paid fortnightly.

In deciding which interval to use there were two problems that the merchant had to balance one against the other. To collect weekly or fortnightly would result in higher collection expenses; on the other hand, in such cases the loss from unpaid accounts would probably be less. Payments on the installment account could be arranged to coincide with the receipt of the purchaser's wages. In many cases, the installment creditor made a practice of cashing the installment purchaser's pay check. This had a double advantage for the merchant; it gave him information about the income of the purchaser and it insured prompt, periodic payments.

Finance companies did not, as a rule, take contracts that called for weekly collections. It happened in several cases, however, that contracts involving weekly collections were sold to a finance company, but in such cases the merchant made the weekly collections himself, and remitted to the finance company at the end of the month.

The contracts studied were divided fairly evenly into those in which the payments were completed in less than one year, in one year, and in more than one year. The shortest contract was for 4 months and the longest for 24 months. Those contracts that were to be paid in weekly installments ran, on the average, for 46 weeks, just slightly under one year; and those that were on a monthly basis ran, on the average, for 13 months, just over one year. One of the merchants interviewed said that it was his policy to arrange the payments on the weekly contracts in such a way that these contracts were completed within a year even if the purchaser missed one or two payments.

The average amount of the periodic payments made on all contracts was $5.09. Since the payments could be made weekly, fortnightly, or monthly, the average for all payments did not give a wholly true picture. The small payments tended to be on those contracts that had the shorter payment interval. The variation in the payments made was rather small. The amount of the payment seemed to concentrate at certain figures. For example, a little less than half of the monthly contracts called for payment of from $4.45 to $5.44 per month, and about the same proportion of the weekly contracts called for a payment of $1.00 a week (table 11). It would appear that while people vary rather widely in the amount that they pay at the beginning of the transaction, there is much less variation in the amount they pay periodically, even taking price into consideration (table 14, page 20).

TABLE 11. DISTRIBUTION OF CONTRACTS ACCORDING TO INTERVAL AND AMOUNT OF PERIODIC PAYMENT

(310 installment contracts for washing machines from 284 stores in New York State, 1937–38)

Interval and amount of periodic payment	Number of contracts		Per cent	
Month:		259		100
Less than $4.45	33		13	
$4.45 to $5.44	119		46	
$5.45 to $6.44	49		19	
$6.45 and over	58		22	
Week:		49		100
$1.00	20		41	
$1.01 to $1.50	14		28	
$1.51 and over*	15		31	
Fortnight:		2		100
$2.00	2		100	

*Highest periodic payment was $3.00.

If a comparison is made between a loan and an installment purchase, the finance charge may be considered as the amount of interest that is paid. In the cases studied, this amounted on the average to $7.26. In eight cases no finance charge was made.

If the finance charge is considered as the amount of interest, then the rate of interest paid may be calculated. This rate of interest is called the cost-rate in this study, and corresponds to the expression of the charge as a percentage per year on the decreasing unpaid balance. The cost-rate was not given in any of the cases studied, but was calculated from other data given in the records. It is a calculation which calls for the use of arithmetic but which is possible for all purchasers to make for themselves.

Several points must be kept in mind when such a calculation is made, however. In the first place, there has been considerable objection on the part of merchants and finance companies to the designation of the carrying charge as *interest* because, it is said, this charge covers not only what would ordinarily be considered interest, but also the cost of investigation, the cost of putting the account on the books, the cost of collecting the periodic payments, and the losses that might result from repossessions. Also, while the balance of the cash price remaining after the initial payment has been made, which in the cases studied averaged $65, could be considered as the principal of a loan, this would be the principal only until the first periodic payment was made, at which time the principal would be reduced. Since each periodic payment on an installment purchase is usually considered as composed partly of payment on the interest and partly of payment on the principal, the principal is reduced with each payment. The balance existing at the beginning of the transaction, therefore, is the principal only at one period and is much larger than the average principal for the whole life of the loan. There is no way of knowing, however, from most installment contracts just how much reduction takes place in the principal with each payment, for the usual installment contract does not designate what proportion of each payment is to be considered as interest and what proportion as a reduction of the principal.

In this study, an equivalent interest rate, or cost-rate, was calculated from the two formulae:[2]

$$r=\frac{2mI}{B\,(n+1)}$$

Used when all payments were equal

and

$$r=\frac{2mI\,(B+I)}{Bn\,(B+I+z)}$$

Used when the last payment was not the same as the other payments

These formulae assume that each payment contains the same proportion of principal and interest. While several other methods could have been used, this method, sometimes called the "constant ratio" method, is the simplest to calculate, and has been most widely used in the other studies that have been made.

The average cost rate obtained by these formulae in the contracts studied was 20 per cent. In many stores if the payments on a purchase were completed in 30, 60, or 90 days, only the cash price was charged; no finance charge was added. This might be done in the case of open book accounts, or, if the installment purchaser paid cash within this period, any finance charge previously paid on the purchase might be refunded. In such cases, it might be considered that the installment customer paid the additional charge for the credit privilege, not for the whole duration of the contract, but only for the time that the contract ran beyond the free-credit period. This, of course, would shorten the length of the period for which the credit was granted, and therefore increase the cost-rate. In the case of the contracts studied, when the cost-rate was adjusted for this free-credit period, it was 26 per cent, on the average.

In the majority of the contracts studied, it was said by the merchant that some refund of the finance charge would be made if the customer completed his payments ahead of the time required by the contract. In 50 per cent of the contracts, however, the store simply stated that some refund would be made, and in only 26 per cent of the cases was this refund specific; that is, it was stated that a definite percentage or amount of the finance charge would be refunded if the contract was paid in advance of the due date (table 12). As has been pointed out in the discussion of methods of quoting the charge, it is difficult for the customer to know how much refund will be made.

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[2] The following is an explanation of the terms in the formulae:

r, rate per year expressed as a decimal fraction
m, number of payment periods in one year. (For monthly payments, "m" is 12; for weekly payments "m" is 52; etc.)
I, total carrying charge or interest in dollars
B, unpaid balance at the beginning of the credit period (cash price less the total original payment, if any)
n, number of payments called for in the credit terms, not counting the down-payment
z, the last payment in dollars in cases where it differs from the other payments.

TABLE 12. PERCENTAGE DISTRIBUTION OF CONTRACTS ACCORDING TO REFUND ARRANGEMENTS IF PAYMENTS WERE COMPLETED BEFORE DUE DATE
(310 installment contracts for washing machines from 284 stores in New York State, 1937–38)

Refund arrangement	Per cent of contracts
No refund made	8
Refund made only if contract completed within first 30 to 90 days	11
Some refund made, but no specific amount mentioned	50
Exact refund made	26
Store had no information since arrangements must be made with another party	5
Total	100

It was stated in connection with the majority of the contracts studied, that no charge was made if the customer failed to make his payment at the date due (table 13). However, in 15 per cent of the cases a charge was made even if payment was made less than one month after the due date. This charge was usually made, however, in the guise of a discount which was given if the payment was made promptly, and a few days of grace were allowed. In 21 per cent of the contracts a charge was levied if the customer delayed for a month or more; in 5 per cent of these cases, however, the charge was made only if the failure to pay caused the contract to run over the original time. That is, if payments were not made for two months, but on the third month all payments were brought up to date, and the contract completely paid at the termination date, no charge would be made. However, a customer might make no payments for two months, but on the third month resume his regular payment; in this case, at the original date of termination the contract would be extended for two months, and an additional charge made for this extension. In 10 per cent of the contracts the merchants said that the conditions causing the failure to make the payment would determine whether or not a charge would be levied.

TABLE 13. PERCENTAGE DISTRIBUTION OF CONTRACTS ACCORDING TO PENALTY FOR DELAY IN PAYMENTS
(308 installment contracts for washing machines from 282 stores in New York State, 1937–38)

Penalty	Per cent of contracts
No penalty	52
Penalty, if payment delayed for period of less than one month	15
Penalty, if payment delayed for period of one month	11
Penalty, varied with customer and conditions	10
Extra charge added, if contract extended over the contract period	5
Penalty, if payment delayed for period of more than one month	5
Charge levied by agency other than store, and store had no information	2
Total	100

CAUSES OF SOME OF THE VARIATIONS IN THESE TERMS

As has been pointed out in the preceding section, there was considerable variation in all terms of the contracts. An attempt was made to see how these variations affected the other terms of the contracts. Four factors that could well have had some effect on the other terms are: the original price, in cash, of the washing machine purchased; the balance remaining to be paid after the original payments had been made; the length of time taken to complete the payments; and the interval in which payments were made.

Those persons who purchased a high-priced washing machine not only made a larger initial payment than did those who purchased a low-priced one, but this initial payment represented a larger percentage of the cash price (table 14). However, those persons who purchased a high-priced machine did not make much larger periodic payments, nor were these payments larger in relation to the balance remaining to be paid, than those made by the purchasers of a low-priced washing machine. In other words, those persons who purchased high-priced machines took a longer time to pay the contracts than did those who purchased low-priced machines, although from their initial payments it would appear that the former were in a position to pay more quickly for their purchases.

TABLE 14. CASH PRICE OF THE WASHING MACHINES, AND OTHER TERMS OF THE CONTRACTS

(310 installment contracts for washing machines from 284 stores in New York State, 1937–38)

Cash price of washing machine purchased	Number of contracts	Average initial payment	Per cent initial payment was of cash price	Average length of contract		Average periodic payment	Per cent periodic payment was of balance remaining	Average finance charge	Average cost-rate (per cent)
				Weeks	Months				
Less than $60	64	$ 6	12	43	11	$3.50	8	$ 4.85	26
$60 to $79	129	9	13	47	12	4.85	8	6.07	21
$80 to $99	65	12	15	51	15	5.57	8	7.58	17
$100 and over	52	23	19	47	17	7.06	7	12.76	17
All contracts	310	$11	15	46	13	$5.09	8	$ 7.26	20

Those persons who bought the high-priced washing machine paid, on the average, a higher finance charge, although they paid a lower cost-rate. This point is worthy of emphasis, for if the charge were quoted as a percentage per year of the decreasing unpaid balance, unscrupulous sellers might not tell the customer the amount of the finance charge, but only state to them the fact that the rate on the higher-priced article was smaller. Thus if the cost-rate is stated, the amount of the finance charge must also be given in order that the cost-rate alone may not be misleading to the unwary.

Changes in the balance of the cash price remaining to be paid had about the same effect on the other terms of the contract as did changes in the cash price itself. Those persons who had a large balance remaining to be paid after their initial payments, made slightly larger periodic payments, took a somewhat longer time to pay the contract, and paid a larger finance charge but a lower cost-rate, than did those who had a small balance remaining to be paid (table 15). Here again the opposite movements of the finance charge and the cost-rate should be emphasized.

Purchasers should understand clearly that a low cost-rate is frequently not accompanied by a low finance charge. This is due to the fact that certain costs of credit, such as cost of investigation and of putting the account on the books, are fixed, and therefore the same for a $10 purchase as

TABLE 15. BALANCE OF CASH PRICE REMAINING AFTER INITIAL PAYMENT, AND OTHER TERMS OF THE CONTRACTS
(310 installment contracts for washing machines from 284 stores in New York State, 1937–38)

Balance of cash price remaining after initial payment	Number of contracts	Average periodic payment		Average length of contract		Average finance charge	Average cost-rate (per cent)
		Weekly	Monthly	Weeks	Months		
Less than $50	63	$1.44	$4.70	38	11	$ 4.84	28
$50 to $59	76	1.24	5.14	50	12	5.69	20
$60 to $69	71	1.47	5.87	50	13	6.42	19
$70 to $79	39	1.65	6.49	53	13	7.51	17
$80 and over	61	2.00	6.90	50	18	12.52	17
All contracts	310	$1.45	$5.81	46	13	$ 7.26	20

for a $100 purchase, and the same for a 6-month as for a 2-year contract. The rate on a $10 purchase must be higher to yield an amount sufficient to cover these costs, than on a $100 purchase. If and when stores make a more serious effort to arrange their charges according to the cost of handling accounts of different amounts, the cost-rate would probably be less for the larger amounts and contracts that run for a longer time than for small amounts and short-term contracts. However, the amount of the charge for the longer contracts would still be larger than the amount of the charge for the short-term contracts. It would then be even more important than it is now for purchasers to know both the amount and the rate of the charge. This same principle is illustrated in the "step"-rates used by the small loan companies; in this State the rate for loans of more than $150 is less than the rate for loans of less than $150.

Those persons who paid for their washing machine every week, purchased, on the average, a lower-priced article than did those persons who paid every month (table 16). When the payments were made weekly, the average initial payment and also the percentage of the cash price that this payment represented were lower than in the cases where monthly payments were made. The finance charge was lower and the cost-rate higher in the weekly contracts. It was not surprising that the cost-rate was higher, in as much as the weekly contracts would involve more labor in handling. This is a case in which it might be to the purchaser's advantage to know that the rate was higher, although the merchant probably preferred to have the account on a weekly basis.

TABLE 16. INTERVAL OF PAYMENT, AND OTHER TERMS OF THE CONTRACTS
(310 installment contracts for washing machines from 284 stores in New York State, 1937–38)

Interval of payment	Number of contracts	Average cash price	Average initial payment	Per cent initial payment was of cash price	Average finance charge	Average cost-rate (per cent)
Week	49	$63	$ 7	11	$5.03	24
Fortnight	2	64	5	8	3.00	9
Month	259	79	12	16	7.71	20
All contracts	310	$77	$11	15	$7.26	20

Those contracts that ran for the longest period of time covered washing machines of a higher average price than did those that ran for a shorter time (table 17). When the contracts ran for a long period of time, the purchasers did not seem, on the average, to make much larger initial payments, and these payments represented a smaller percentage of the cash price, than in the case of contracts that ran for a short period of time. The contracts running for a short period of time called for larger amounts to be paid periodically than did those contracts that ran for a long period of time. Apparently those persons who planned to pay for their contracts in a short period of time bought a washing machine at a lower-than-average price, made a fairly substantial initial payment on it, which payment represented a larger-than-average percentage of the cash price, and made larger-than-average periodic payments. These persons paid a lower-than-average finance charge, but a higher-than-average cost-rate. This is another case in which the cost-rate alone might be misleading to the customer who did not understand the meaning of the two ways of expressing the cost of credit.

TABLE 17. LENGTH OF CONTRACTS, AND OTHER TERMS OF THE CONTRACTS
(310 installment contracts for washing machines from 284 stores in New York State, 1937–38)

Length of contract	Number of contracts	Average cash price	Average initial payment	Per cent initial payment was of cash price	Average periodic payment		Average finance charge	Average cost-rate (per cent)
					Weekly	Monthly		
Less than one year . .	91	$64	$11	18	$1.61	$6.82	$ 4.59	24
One year	113	74	11	15	1.17	5.82	6.60	20
Over one year	106	90	12	14	1.14	5.13	10.25	17
All contracts	310	$77	$11	15	$1.45	$5.81	$ 7.26	20

For those interested in the question of terms, the following are suggested:

FITZPATRICK, F. J. Installment selling by department stores during 1938. National Retail Dry Goods Assoc., Credit Management Div. Yearbook **6**: 45–53. 1939.

FOSTER, LEB. R. Instalment credit costs and the consumer. Univ. of Chicago. Journ. of bus. **8**: 27–45. 1935.

FROMAN, L. A. The cost of installment buying. Harvard bus. rev. **11**: 227–236. 1933.

MERRIAM, M. L. The trend of installment terms, December 1936–37, p. 1–30. U. S. Commerce Dept. Mimeo. rept. March 4, 1938.

PLUMMER, W. C. Social and economic consequences of buying on the installment plan. Amer. Acad. of Polit. and Soc. Sci. Ann. **129** (sup.): 1–57. 1927.

OCCUPATION AND INCOME OF THE PURCHASERS OF WASHING MACHINES ON INSTALLMENT CREDIT

Information concerning the income and occupation of the purchasers whose contracts were studied was obtained from records that the stores had and with no identification of the persons. Many of the stores did not supply such information, sometimes because they could not, and sometimes because they did not wish to divulge information about their customers. Since these data represent only what the store knew of the customer, they may not, of course, be complete or accurate, but if incomes and occupations have any influence on the procedures of the store, this would be the information that was used. The persons for whom incomes were given were not always the same ones for whom occupations also were given.

Almost half of the purchasers for whom occupations were reported were unskilled workers (table 18). These purchasers bought a washing machine of a slightly lower than average price. They also made the lowest initial payment of all groups of purchasers, and this represented the smallest percentage of the cash price. These purchasers also made smaller-than-average periodic payments and paid smaller-than-average finance charges. The occupation of the purchaser did not seem to make any difference in the cost-rate that was paid.

TABLE 18. OCCUPATIONS OF PURCHASERS AND TERMS OF THEIR CONTRACTS
(258 installment contracts for washing machines from 238 stores in New York State, 1937–38)

Occupation of purchasers	Number of contracts	Average cash price	Average initial payment	Per cent initial payment was of cash price	Average periodic payment	Average finance charge	Average cost-rate (per cent)
W. P. A. workers	2	$61	$13	20	$3.00	$6.50	27
Unskilled workers	128	71	10	13	4.58	6.75	20
Skilled workers	43	79	14	18	5.24	7.59	20
Clerical workers, salespersons, and guards	26	88	13	15	4.85	8.50	19
Business of own, and retired	39	80	12	15	6.11	8.01	21
Supervisory, semi-professional, and professional workers	20	87	18	20	6.35	7.56	19
All contracts	258	$77	$12	15	$5.07	$7.32	20

It was reasonably clear that income had some influence on the price that was paid for a washing machine (table 19). All the payments that were made by those with the lowest incomes were the lowest payments made: the initial payment, and the percentage that this represented of the

TABLE 19. INCOMES OF PURCHASERS AND TERMS OF THEIR CONTRACTS
(198 installment contracts for washing machines from 182 stores in New York State, 1937–38)

Income of purchasers	Number of contracts	Average cash price	Average initial payment	Per cent initial payment was of cash price	Average periodic payment	Average finance charge	Average cost-rate (per cent)
Less than $1,050	53	$67	$ 8	12	$4.49	$6.11	21
$1,050 to $1,549	75	78	10	13	5.12	8.48	21
$1,550 to $2,049	52	84	13	16	4.95	7.05	16
$2,050 and over	18	82	17	20	6.07	7.45	19
All contracts	198	$77	$11	14	$4.99	$7.37	20

cash price, the periodic payment, and the finance charge. The initial payment was noticeably lower for those with low incomes, while in the periodic payments there was little difference. However, those purchasers who had the lowest incomes paid a somewhat larger cost-rate than did those with higher incomes. It would appear from these figures that either the stores were exercising some caution in regard to the price of washing machines that were sold to persons with low incomes, or those persons were careful on their own account.

A few studies exist concerning persons who purchase on installment credit, among which are the following:

[ANON.] Cost of living of federal employees in five cities; installment buying. Monthly lab. rev. **29**: 1039–1048. 1929.

EUBANK, E. E. A case study of the effects of consumer credit upon the family. Amer. Acad. of Polit. and Soc. Sci. Ann. **196**: 211–220. 1938.

SADD, V., AND WILLIAMS, R. T. Causes of bankruptcies among consumers. U. S. Commerce Dept. Domestic commerce ser. **82**: 1–37. 1933.

YOUNG, R. A., AND BERNSTEIN, B. The statistical pattern of installment debt. National Bur. Econ. Res. Buls. 76 and 77. 1939.

HOW THE CUSTOMER'S CREDIT STANDING IS INVESTIGATED

Credit investigation is usually thought of as a protective measure taken by the store for its own benefit. This, of course, is true, but the benefit of this investigation also accrues to the purchaser to some extent. Repossessions in general represent a loss, both to the merchant and to the purchaser, as well as to all customers. From its accumulated knowledge of what past purchasers have been able to pay for, and from its present knowledge of the income and other commitments of the purchaser, the store can probably foretell fairly well those customers who will not be able to make their payments. Therefore, any effort that the stores make to prevent these people from undertaking such obligations may be beneficial to all customers, especially to those who are inclined to be overly optimistic about their ability to pay for their purchases on installment credit.

Only three merchants said that they made no effort to investigate the credit standing of their customers (table 20). These three said that they followed a very strict collection policy. They did not check the credit, but unless the account was paid promptly the store repossessed the article at once.

About 60 per cent of the stores conducted at least some of their credit investigation through a credit bureau. Credit-bureau service, however, was not available in most small localities. In such places, there existed some resentment toward credit bureaus since, it was said, those in neighboring cities frequently called for information about customers living in the small locality but making some purchase in the larger city, and the local store received no compensation or return for such service. Credit bureaus, however, probably supply the most satisfactory method of making investigations, since through them the available information about other credit purchases of customers may be pooled. This may

TABLE 20. TYPES OF INVESTIGATION OF CREDIT STANDING OF CUSTOMERS (266 stores, New York State, 1937–38)

Type of investigation	Number of–		Per cent	
	Stores	Washing machines sold	Stores	Washing machines sold
None	3	63	1	*
Through credit bureau	113	18,162	43	67
Through an outside agency other than credit bureau	64	3,601	24	13
Through credit bureau and other outside agency	48	3,091	18	12
By store only	38	2,029	14	8
Total	266	26,946	100	100

*Less than 0.5 per cent.

prevent customers from being over-sold even if they are inclined to overbuy on installment credit.

In 64 stores, or 24 per cent of those visited, the merchants said that the investigation was done by some outside agency other than the credit bureau, an agency that might also be financing the contracts. This might be a bank, a finance company, or a public-utility company.

Where the public-utility company made the investigation, it was usually only an inquiry as to whether the customer had been a user of current on its lines for two years, and whether he had paid his bills satisfactorily during this period. It may be that while the installment purchase and the charge for current are billed separately, the customer does not think of them separately, and is inclined to believe that if payments on the installment purchase are not made promptly the current will be cut off. Payments may be made more promptly for this reason. The investigation carried on by other outside agencies apparently varied considerably but not a great deal of information on this subject could be gathered from the stores.

Forty-eight, or 18 per cent, of the stores made part of their investigations through a credit bureau and part through some other outside agency. Thirty-eight, or 14 per cent, of the stores relied solely on their own credit investigation. This investigation varied widely both in scope and method. In some cases, where the merchant was well acquainted with the neighborhood, he would merely ask for the customer's name and address. If the address seemed satisfactory, that was sufficient. Some stores called other larger stores in town; some asked for references and called these. There was a difference of opinion among merchants as to the value of investigations which they carried on themselves. Some said that they had been so long established that they knew everyone, or could easily find out about them. Others said that they had difficulty in obtaining information; references did not help, they said, because people usually kept some good references for use in such cases. Stores that carried on their own investigations were generally located in small towns, probably partly because credit-bureau service was not available there, and partly because the merchants themselves felt more capable of assessing the credit standing of the purchaser (table 21). Only five per cent of the stores located in towns of a population of less than 4950, however, had credit departments of their own (table 22).

TABLE 21. DISTRIBUTION OF STORES ACCORDING TO SIZE OF TOWN AND TYPE OF INVESTIGATION OF CREDIT STANDING OF CUSTOMER
(266 stores, New York State, 1937–38)

Population	Type of investigation									
	None	Through credit bureau	Through an out-outside agency other than credit bureau	Through a credit bureau and other outside agency	By store only	None	Through credit bureau	Through an out-outside agency other than credit bureau	Through a credit bureau and other outside agency	By store only
	Number of stores					Per cent				
Less than 4,950...	1	4	24	6	24	33	4	37	12	63
4,950 to 19,949..	.	35	18	18	5	..	31	28	38	13
19,950 to 49,949..	1	35	5	13	2	33	31	8	27	5
49,950 and over....	1	39	17	11	7	33	34	27	23	19
Total.....	3	113	64	48	38	99	100	100	100	100

One aspect of credit investigation that seemed to the writer to need serious consideration was the question of the customer who was able to pay for the article in question, but who was not able to pay for that article and two or three others. This point has been brought out by others who have studied the matter (Sadd and Williams, 1933; Schmalz, 1938; Foster, 1937; Committee on Consumer Credit, 1936). It was particularly emphasized by one merchant visited during this study. He said that he had sold a washing machine to a customer who had later tried to purchase a stove on installment credit before he had completed his payments on the washing machine. This particular merchant refused to sell him the second article, knowing that the customer would have difficulty in paying for both purchases at the same time. The customer went elsewhere and made his purchase. The result was that payments were not made on either piece of equipment, and both were finally repossessed. The merchant, in recounting this experience, was not certain that had the second seller known of the customer's previous commitments, he would have refused to make the sale; but he thought that if he himself had

TABLE 22. PERCENTAGE DISTRIBUTION OF STORES ACCORDING TO SIZE OF TOWN AND PRESENCE OF CREDIT DEPARTMENT
(266 stores, New York State, 1937–38)

Population	Number of stores	Per cent		
		With credit department	With no credit department	All stores
Less than 4,950....................	59	5	95	100
4,950 to 19,949....................	76	22	78	100
19,950 to 49,949....................	56	59	41	100
49,950 and over....................	75	41	59	100
All stores..........................	266	32	68	100

known of the second purchase of the customer he would have watched the account more closely. The fact that another purchase had been made on installment credit, and that payments could not be maintained on both the articles, was cited several times by merchants as the reason for a repossession. (Appendix, page 34.)

One of the possible ways of keeping track of these different commitments is through the filing of contracts as specified by the New York State Uniform Conditional Sales Law.[3] Contracts are filed for the protection of persons, who may later become creditors, against previous liens, and also to prevent difficulty for the installment sellers if liens should be made against the purchasers. It was found in this study that contracts generally were filed only if some question about the customer's credit standing existed in the mind of the seller. The merchant, for instance, may have doubted the customer's ability to pay in the beginning;[4] the customer may have come from out of town, a circumstance that always raised suspicion in the merchant's mind, since the customer's credit rating in his home town might have been too poor for any merchant there to undertake the risk of selling to him on credit; the purchase may have involved so large a sum of money that the merchant felt it necessary to protect himself in all possible ways; or circumstances such as a threatened strike in his place of employment might make the customer's future financial position somewhat questionable. About one-fourth of the merchants always filed their contracts, and about the same proportion never filed their contracts; about 40 per cent of the merchants occasionally filed them for the reasons given earlier (table 23).

TABLE 23. POLICY IN REGARD TO FILING INSTALLMENT CONTRACTS FOR WASHING MACHINES
(266 stores, New York State, 1937–38)

Policy in regard to filing	Number of–		Per cent	
	Stores	Washing machines sold	Stores	Washing machines sold
Filing done by others; store did not know whether contracts were filed or not	9	513	3	2
All contracts filed	73	7,346	28	27
No contracts filed	75	8,024	28	30
Some contracts filed	109	11,063	41	41
Total	266	26,946	100	100

The chief reasons given for not filing the contracts, or filing only some of them, were that the customer did not desire to have his business made common property; that some customers refused to purchase if the contracts were to be filed; that there was some cost involved in filing; and that filing was something of an effort. The anxiety of the merchant to respect the customer's secretiveness in financial matters works strongly against the need of the credit grantor for adequate information, both for his and the customer's protection. The merchant cannot be blamed greatly for this situation, however, as he can hardly be expected to make a move that he feels would incur the hostility of his customers. It should be pointed out, nevertheless, that the present policy of filing only those contracts in which there is some doubt about the customer's ability to pay would certainly be one reason for customer resentment of this practice.

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[3] Article 4 of the Personal Property Law.

[4] While making sales to doubtful customers is not a practice that can be approved by those interested in the welfare of the customer, it does occur. It might be well for merchants who do this to note the frequency with which it is implied, at least, in the reasons for repossessions, that the merchant was somewhat at fault in granting the credit (page 34).

Further information about credit investigation made by stores may be found in:

Bowers, W. A. Furniture distribution in the Gulf Southwest. U. S. Commerce Dept. Domestic commerce ser. **76**: 117–120. 1932.
Phelps, C. W. Controlled installment credit, p. 1–43. Household Finance Corp. 1938.
Yearbooks of the Credit Management Division, National Retail Dry Goods Association.

Articles of this nature are generally written from the point of view of preventing losses to the store, but the bearing this has on the customer's problems may be easily discerned.

EXTENT OF REPOSSESSIONS OF WASHING MACHINES

Information about repossessions were gathered in two ways in this study. In the first place, the store was asked to report the number of repossessions of washing machines that were made during the past year. In addition to this, the store was asked to give more complete information about one repossession that had been made. Seventy-three records of these repossessions were obtained from 70 stores.

Numbers of reposessions are one of the ways in which a check can be made on whether the granting of credit is carried on in a manner satisfactory both from the consumer's and the store's point of view. In this study, it was found that, on the average, 1.3 washing machines were repossessed out of every 100 sales that were made, and 1.6 washing machines were repossessed out of every 100 sales that were made on installment credit.

In studying these repossessions, several qualifications must be kept in mind. In the first place, a washing machine is an article that is not frequently repossessed. The nature of the article means that it is usually purchased by a person in a fairly permanent location, generally by a member of a family group. Such persons are generally considered good credit risks. A washing machine is an article that is not changed often in style or model. As was emphasized by many merchants, the figures on repossessions for this article would be much lower than those on radios, for example, where the style element and yearly changes of model, with the subsequent drop in the price of the past year's model, make the installment purchaser unwilling to continue payments on an article that could be purchased at a much lower price. In general, the families purchasing washing machines were from an economic group subject to many hazards in employment. A threatened strike in one area curtailed sales of washing machines. In another locality, the merchants had been forced to carry their installment customers through a strike of eleven week's duration.

In interpreting these data, it must also be kept in mind that not all repossessions may be accounted for. Some few stores were financing their installment contracts on a non-recourse or limited-recourse basis. In such cases, the outside financing agency might have made some repossessions that were not reported by the store, although most of the stores reported that they preferred to repurchase the repossessed article in order to have control over the secondhand sales of this article.

The fact that repossessions were small in number still might not represent a completely satisfactory situation from the customer's point of view. In several instances, the merchants said that their chief problem was to avoid making the repossessions that were possible. A customer sometimes would regret a purchase and desire to end his obligation by allowing the machine to revert to the store. Such action is probably due in part to the customer's lack of understanding of the terms of the contract before the purchase was made. Since it was usually more profitable for the store to have the payments completed, considerable effort was exerted to prevent repossession when the customer could continue the payments. In the future, if stores should engage in installment sales of articles that have little repossession value, this problem will probably become more acute.

Repossessions were slightly larger in small towns than they were in the large centers (table 24). This was rather surprising as it might be thought that there would be more reluctance on the part of the stores to repossess where the fact would be widely known to the customers. Two reasons may account for this fact. In the small towns, the finance companies were handling a larger percentage of the contracts than in the larger centers, and the rate of repossessions was greater for the finance companies (table 25). This might be expected since, as was pointed out earlier, the finance company does not have the intimate and continuing relationship with the purchaser that the merchant has, and in addition, there was also some tendency for the merchants to turn the poorer contracts over to the finance companies, or perhaps it might be better to say, that they kept the best contracts for themselves. The other fact that might account for the larger number of repossessions in the small centers was the investigation that was done in them: the credit investigation was less standardized, fewer stores had their own credit departments, and the use of the services of credit bureaus was not

TABLE 24. NUMBER OF REPOSSESSIONS OF WASHING MACHINES SOLD ON INSTALLMENT CREDIT, ACCORDING TO SIZE OF TOWN
(262 stores, New York State, 1937–38)

Population	Number of stores	Number of repossessions	
		Per 100 sales	Per 100 sales on installment credit
Less than 4,950	59	1.9	2.6
4,950 to 19,949	75	2.2	2.8
19,950 to 49,949	56	1.5	1.9
49,950 and over	72	0.8	0.9
All stores	262	1.3	1.6

TABLE 25. NUMBER OF REPOSSESSIONS OF WASHING MACHINES SOLD ON INSTALLMENT CREDIT, ACCORDING TO FINANCING AGENCY
(262 stores, New York State, 1937–38)

Financing agency	Number of stores	Number of repossessions	
		Per 100 sales	Per 100 sales on installment credit
Store, alone	95	0.8	0.9
Store and one other agency	73	1.5	1.9
Store and two other agencies	8	2.9	3.5
Finance company, alone	61	2.4	3.1
Finance company and one other agency	63	1.9	2.4
Finance company and two other agencies	8	2.9	3.5
Single agency other than store or finance company	19	1.2	1.4

possible in some cases. Both of these latter methods of credit investigation appeared to keep repossessions lower than the average (tables 26 and 27).

TABLE 26. NUMBER OF REPOSSESSIONS OF WASHING MACHINES SOLD ON INSTALLMENT CREDIT, ACCORDING TO PRESENCE OF CREDIT DEPARTMENT IN THE STORE
(262 stores, New York State, 1937–38)

Presence of credit department	Number of stores	Number of repossessions	
		Per 100 sales	Per 100 sales on installment credit
No credit department in store	182	1.8	2.2
Credit department in store	80	1.0	1.2

TABLE 27. NUMBER OF REPOSSESSIONS OF WASHING MACHINES SOLD ON INSTALLMENT CREDIT, ACCORDING TO TYPE OF INVESTIGATION OF THE CREDIT STANDING OF THE CUSTOMER
(262 stores, New York State, 1937–38)

Type of investigation	Number of stores	Number of repossessions	
		Per 100 sales	Per 100 sales on installment credit
None	3	3.2	3.3
Through credit bureau	111	1.1	1.3
Through outside agency other than credit bureau	64	1.8	2.5
Through a credit bureau and other outside agency	48	2.1	2.6
By store only	36	1.5	1.8
All stores	262	1.3	1.6

From those 73 records of actual repossessions obtained, the average amount that the customer had agreed to pay was $85.68, and of this amount, $28.45 was paid, or about one-third of the amount that the customer had contracted to pay. This information was obtained by asking the merchant about the repossession, and perhaps it was naturally somewhat biased. The merchants stated in several instances, however, that their own laxness was to blame for repossessions (Appendix, page 34). In 41, or more than half, of the cases, conditions out of the control of either the store or the customer, caused the customer to discontinue the payments, and caused the machine to revert to the store. Unemployment was the most important of these reasons. Family conditions such as illness, death, or marital difficulties were also important causes for repossessions. Frequently overbuying was at least a contributing cause for repossession. In many of the cases, it was apparent that had more consideration been given to the purchaser's general situation, the sale never would have been made. Unless either the buyer or the seller were profiting by these repossessions, it would appear that further investigation would have been advantageous to both.

It would also appear that the stores in general were not anxious to make these repossessions, since, on the average, it was stated that three and one half months were allowed to lapse after the last payment was made before the machine was brought back to the store.

The subject of repossessions may be studied in:

New York State Uniform Conditional Sales Law, Article 4 of the Personal Property Law, sections 76 to 80.

SELIGMAN, E. R. A. Economics of instalment selling, 2:477–520. 1927.

CONCLUSIONS

Sales of washing machines are most frequently made on installment credit, and therefore policies and practices in this type of sale have significance for both customer and merchant.

One of the outstanding problems in the sale of washing machines on installment credit is in the use of many different methods for expressing the charge for this type of credit. Part of this variation is probably caused by the fact that a number of different agencies finance the contracts. In the study upon which this bulletin is based, the stores, as well as the financing agencies, were of many different types and were not united in any way that would promote standardization among themselves. Joint consideration of this problem might be one step toward improving the situation.

Installment purchasers should consider not only the amount of the charge, but the various methods of stating the charge, and which method from their point of view is most satisfactory. Thought on their part and the expression of such thought probably would have some influence at present, when methods of stating charges are under discussion.

In considering methods of expressing the charge, it should be kept in mind that customers do not make a standardized initial payment, nor do they wish to pay their contracts in the same length of time. This means that individual arrangements have to be made by the merchant, and that the charge must vary with the different circumstances. The present payment schedules used by the finance companies allow for this, but they do not state the amount of the finance charge, which must therefore be calculated by the purchaser. Furthermore, these schedules are not as clearly and conspicuously presented to the customer as they might be. Too frequently they are consulted only by the salesman, not by the customer.

The method of expressing the charge as a percentage per year of the decreasing unpaid balance was not used by any of the merchants visited in the study here reported. Such an expression of the charge would be helpful, at least to those who understood it. There are two points, however, that should be kept in mind in regard to such a method of quoting the charge. In the first place, one of the chief reasons why this method has not been welcomed by merchants is that the general public believes that 6 or 8 per cent is the correct and proper charge for credit. Despite the fact that a higher charge than this has been made legitimately by the small-loan companies for some time, the public still recognizes no difference in costs of granting credit. Responsibility for instructing the public about such differences must be assumed by those advocating a percentage quotation of this kind. In the second place, the charge should be expressed also in dollars and cents, a method as yet by no means universally used. Without the dollar-and-cent charge, the rate of percentage per year of the decreasing unpaid balance, or cost-rate as it is frequently called, is sometimes misleading. For example, from the data in the study reported in this bulletin, the installment buyer might have considered the high-priced washing machine the "best buy" if only the cost-rate were given, for the cost-rate was lower than for the low-priced machines; the amount of the finance charge was higher, however. If stores should make a more serious effort to arrange their charges according to the cost of handling accounts of different amounts, it would be more important than it is now for the purchaser to know both the cost-rate and the amount of the charge, since then the difference in the cost-rate for small and large purchases might be much greater than it is now.

Repossessions, like all types of failure to meet incurred obligations, result in losses. This means losses not only to the individual who fails to make the payment, and thus loses his purchase, but also to the person who fails to receive the payment, and who will attempt to pass on the loss in the form of an additional cost to the store's other customers. The prevention of such losses is, therefore, a problem facing household buyers in general, as well as those buyers whose articles are repossessed and the merchants concerned.

It is common knowledge that information is sought by merchants about customers' credit ratings. Investigations of this nature are expensive. Clear presentation of his financial status by the prospective credit purchaser is one way in which help can be given by those customers wishing to cooperate with stores in reducing costs. The advisability of such protective devices as the filing of contracts, a practice designed to keep merchants informed of customer commitments, is another measure that might well be considered.

Preventable credit losses should be recognized not merely as a store problem, but as a problem for all persons; and in the case of articles such as washing machines, for which the credit sales are large, as an especially important problem.

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APPENDIX

REASONS GIVEN FOR 73 REPOSSESSIONS OF WASHING MACHINES BY 70 STORES

Customer unwilling to complete payments (12):

- Did not like machine.
- Have not had sufficient service on machine but store said that since it had given customer an allowance for damage to machine, the customer thought that complaint was an easy way to avoid payments.
- Customer was buying a car. "Slippery" or "crooked".
- Customer was bad from beginning. Moved out of town leaving no address, but since did not pay mover he reported the new address.
- Man was "crooked". Left town. Kept one or two good references but owed all others.
- Stopped paying and moved machine. Damaged machine purposely in order to try to prevent store from collecting.
- Just did not pay.
- Would not pay.
- Lost interest and let go back. Was working steadily.
- Customer says he is out of work but is known to have had work. Curious case because store can sell the machine for more than is owed and has told purchaser of this buyer but he sent the washing machine back.
- Refused to pay. Is unemployed but also had lost interest.
- Family unstable. When son joined army, stopped paying.

Ability to complete payments misjudged (18):

- Too little money and 3 or 4 children.
- No money.
- Widow with children, suing, and expected to get money from suit to pay for machine. Has not done so.
- Bought a lot of furniture. Paying $3 a week.
- Bought truck and found could not pay for both so brought back washer. Lost job in gas station. Was not a first-class risk to begin with.
- Payments irregular. Making payments on truck. Bought beyond his means.
- Bought refrigerator on same contract and did not want it when cold weather started, so brought back washer too.
- Poor management. Had queer tendencies.
- Poor management. Over-buying. Radio and washer purchased.
- Poor management. Were earning but get into too much debt.
- Other merchandise purchased. Were working but not steadily. Were poor credit risk.
- Family left town. Left radio also. Had so many debts that thought they never could pay them. Debts were one of the reasons for moving.

Husband earns usually $17 a week, sometimes not more than $13. Has wife and twins. Said in store "Don't know why we ever sold to him."
Unemployed. Was poor credit risk and salesman never should have made sale.
Should have checked. Was poor credit risk.
Son-in-law started payments. Mother-in-law continued them but could not keep them up.
Farmer was going to pay from odd jobs which never materialized. Was not good credit risk but store was overstocked with that type of washer.
Machine left 3 months. Purchaser did not think store gave enough time to pay.

Conditions, out of control of customer, arose which caused customer to stop payments (41):

Breaking up home.
Husband died. Wife went to live elsewhere.
Family broke up. Wife died.
Family trouble. Husband left wife and she could not keep up payments.
Home broken up. Man who was responsible for payments no longer needs machine.
Wife left husband. He no longer needs machine.
Man and woman past middle age purchased the machine. Woman died. Man gave machine to daughter but she did want to finish payments.
Mother for whom machine was purchased died. Daughter decided not to continue payments.
Brother wanted machine for a debt. Purchaser voluntarily returned the machine. Very unusual because repossession is not practiced.
Family had bad luck in working.
Tuberculosis. No margin for emergencies.
Wife sick. Emergency bills. Could have continued payments but took this opportunity to get out of payments.
No reserve for emergencies.
Unemployment.
Out of work. Store gave them a second-hand machine.
Lost job. Left town. Just left machine when they moved. Doubtful to begin with.
Man injured and out of work. Could not get any compensation.
Unemployed. Man and child injured.
Out of work. Five children. Credit rating very good. Girl in store said this would not injure his credit because he could not help it. Had kept the machine in excellent condition.
Out of work; then moved. Can still get the machine if they pay in six weeks.
Lost job. Psychopathic-hospital case.
Bankruptcy.
Bought electric washer and then moved where there was no electricity (tenant farmer).

No reason given (2).

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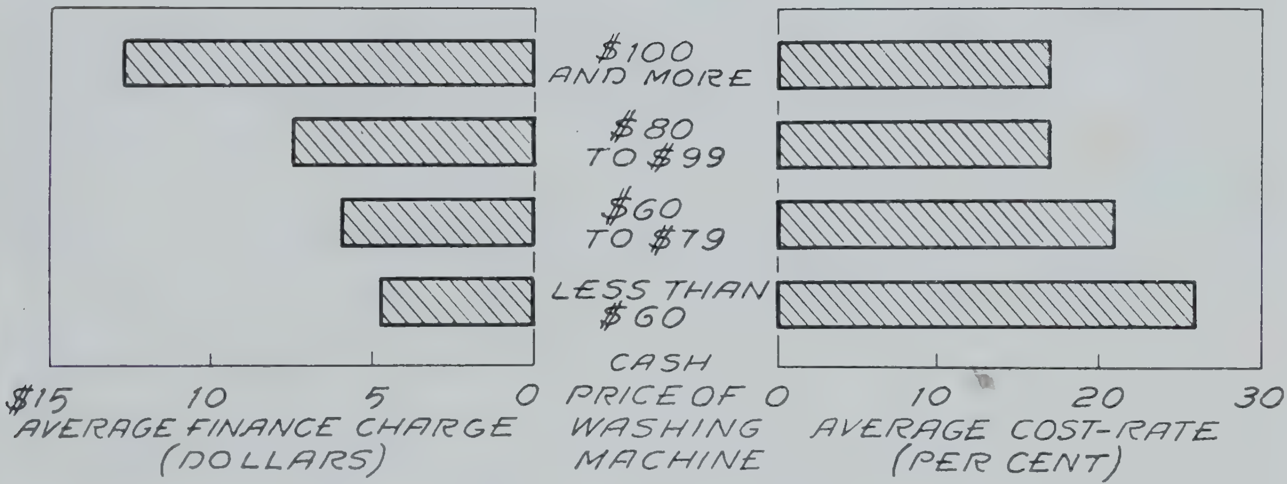
Installment Credit in the Sale of Washing Machines

Mabel A. Rollins



CASH PRICE OF WASHING MACHINES PURCHASED, AND CHARGE FOR INSTALLMENT PRIVILEGE IN DOLLARS AND AS A RATE

Although the dollar charge for installment credit was higher on the higher-priced machines, the annual rate was lower

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INSTALLMENT CREDIT IN THE SALE OF WASHING MACHINES

Mabel A. Rollins

Since consumer credit is used by many persons today, it should be understood as fully as possible. Consumer credit has been defined as credit granted for consumption with no expectation that direct monetary profit will arise from its use. While this bulletin relates to only one aspect of the problem, a brief discussion of the broader field may help to place the findings here presented in their proper perspective.

The subject of consumer credit has been widely discussed and debated. Some persons have held that it is beneficial to consumers in that it enables those with low incomes to purchase goods that would not otherwise be available to them; that it makes goods available to consumers when needed instead of their use being postponed until sufficient money is saved to buy them; that those who never could or would save the money to make the purchase outright can and will pay for articles that they have already purchased. In this way, it is argued, people with low incomes may acquire articles of greater utility than they might purchase if they bought only what their available cash would permit. Furthermore, it is said that articles of a high unit value, such as automobiles, refrigerators, and washing machines, thus become available for mass distribution, a process that is essential if advantage is to be taken of savings by mass production.

On the other hand, persons who feel that consumer credit has brought more harm than good, say that the unwary are induced to purchase articles not needed or wanted, because the initial step is so easy—the down-payment is small and the contract is signed and the purchaser bound by it before he realizes what he has done. Further, it is pointed out that such purchasers are too inexperienced to know what their legal rights are and may be easily exploited by the unscrupulous. It is said also that the charge for this type of credit is high and is levied on the class of people least able to afford it.

These and many other arguments are brought up by each side. Some are unproved, others unprovable, and a large number are not supported by sufficient data, although an increasing body of factual information is becoming available. The study[1] upon which this bulletin is based was undertaken by the Department of Economics of the Household and Household Management of the New York State College of Home Economics, in an effort to add to the body of facts now available to the public.

There are two forms in which credit for consumers may be obtained, in money or in goods. For the former, there are several sources, such as personal-loan departments of commercial banks, industrial banks, credit unions, small-loan companies, and pawn shops. For credit in goods there is only one source, the retail store. This latter type of credit may be granted in two forms, however, either as open credit or as installment credit. Credit in goods is more widely used than is credit in money (table

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[1] Reported in a thesis entitled *Some Store Practices in the Sale of Washing Machines on Installment Credit*, by Mabel A. Rollins; this was presented to the Faculty of the Graduate School of Cornell University, February, 1940, in partial fulfillment of the requirements for the degree of doctor of philosophy.

1). These two forms cannot be wholly separated, however, because consumers frequently borrow money in order to make purchases of goods.

TABLE 1. SOME AGENCIES ENGAGED IN GRANTING CREDIT TO CONSUMERS

Credit agencies	Kind of security generally obtained	Amount outstanding (millions)		Per cent of total		Range in usual charges‡ (per cent)
		1936*	1935†	1936*	1935†	
Personal-loan departments of banks	Marketable security for collateral Co-maker	$ 129	$ 40	2	1	6–23
Industrial banks	Co-maker	234	110	5	2	12–34
Credit unions	Knowledge of borrower	55	40	1	1	8–18
Small-loan companies	Chattel mortgage	285	225	6	4	30–42
Pawn shops	Article deposited	110	110	2	2	24–120
Retail stores:						
Open credit accounts	Credit standing of purchaser	1,500	2,800	30	46	§
Installment credit	Article purchased	2,600	2,100	51	34	0–500
Other||	....	153	645	3	10	......
Total	....	$5,066	$6,075	100	100	......

*Grobben, M. Volume and classification of consumer loans. Amer. Acad. of Polit. and Soc. Sci. Annals **196:** 74. 1938.

†[Anon.] Credit for consumers. Public affairs pamphlet 5:21. 1936.

‡[Anon.] Credit for consumers. Public affairs pamphlet 5:22. 1936.

§It is generally assumed that the charge is included in the mark-up.

||Includes remedial loans, illegal loans, special loans, commercial-bank personal loans not segregated.

For those who wish to read further on this subject the following bibliography, from which selections may be made, is suggested:

WILDER, E. (compiler). Consumer credit bibliography, p. 1–142, 1938. In addition, readings on particular subjects are suggested at the end of each section.

It is always advisable for those who are contemplating the use of installment credit to investigate not only the cost of this type of credit at more than one store but also the cost if the money were borrowed and cash paid for the article.

The study here reported considered one aspect of credit in goods, that of installment credit, with special reference to the sales of washing machines. This particular commodity was chosen because it is one in which many homemakers are interested and because a high proportion of the sales are made on installment credit. The information was collected through personal interviews with merchants or credit men in 290 stores selling washing machines in New York State towns and villages during 1938. The part of the study concerning the terms on which the washing machines were sold, the prices of the machines, the down-payments, the finance charges, and the like, is based on 310 contracts that the merchants were asked to select as typical of the sales on installment credit that had been made in their stores during the preceding year. This method of course allowed the merchant to select those contracts that presented his terms in the most favorable light, if he wished to do so, and the stores whose practices were questionable may have been among those that refused to contribute information, since participation in the study was voluntary; however, it had the advantage of supplying information on actual installment sales.

EXTENT OF INSTALLMENT SALES OF WASHING MACHINES

The majority of washing machines are sold on installment credit, it is usually agreed. In this study, 266 stores from which usable records were obtained made approximately 80 per cent of their sales in this fashion. This percentage was about the same as that estimated by E. R. A. Seligman in 1927.

That the percentage has not changed since that time is not in conflict with the statement often made that installment sales are increasing, because the sales of certain articles, including washing machines, have increased in volume, and, therefore, the number of washing machines sold on installment credit has increased, even though the proportion of sales in this fashion has not changed. Installment sales probably reached their highest percentage to date in 1929, when it was estimated that they represented about 13 per cent of all retail sales.

During periods of increasing sales, such as 1935 and 1936, installment sales seemed to increase more rapidly than did other sales; the reverse, however, appeared to be true during periods when all sales were decreasing, as in 1938, for then installment-credit sales decreased faster than did all sales (table 2).

TABLE 2. PERCENTAGE CHANGE IN INSTALLMENT SALES AND TOTAL SALES, 1934–38*

Years	Percentage change	
	Installment sales	Total sales
1934 to 1935	+19.0	+ 7.8
1935 to 1936	+24.7	+14.9
1936 to 1937	+ 3.1	+ 5.2
1937 to 1938	−28.5	−11.3

*Adapted from LaCrosse (1936:1) and Merriam (1939:7).

Such changes might be expected. While in times of depression some persons may stop their purchases for cash because they wish to keep a reserve against emergencies, the merchant himself may stop some possible installment sales because he, rather than the purchaser, is pessimistic about the ability of the buyer to repay. For instance, in one locality where a strike in the principal industry of the town was threatened, the merchants said that they were making no installment sales of washing machines until the labor difficulty had been cleared up. They also added that they were making practically no sales in any form. The workers were receiving their wages and were willing to make purchases; but there were sales only for cash, and most persons purchase a washing machine only if granted credit.

Stores in small localities tended to sell a slightly smaller percentage of their washing machines on installment credit than did stores located in centers of large population (table 3). In small towns it may have been felt that there was less need of the protective type of credit represented by the installment contract, and, therefore, more use could be made of open credit. It may also have been true that the residents of the smaller centers were less inclined to purchase goods on an installment

TABLE 3. PERCENTAGE OF WASHING MACHINES SOLD ON INSTALLMENT CREDIT, ACCORDING TO SIZE OF TOWN
(266 stores, New York State, 1937–38)

Population	Number of stores	Per cent of washing machines sold on installment credit
Less than 4,950	59	76
4,950 to 19,949	76	81
19,950 to 49,949	56	82
49,950 and more	75	85
All stores	266	83

basis; or they may have been more conservative; or they may have received their income in a form that inclined them less to purchase on installment credit; or they may have preferred to buy in a larger town where the selection was greater, or where it would not be known to their neighbors that they were using this form of credit. Several merchants remarked during the interview that they frequently had inquiries from stores in larger cities about the credit standing of their customers who were making installment purchases in these larger cities. On the other hand, the fact that a piece of equipment such as a washing machine frequently needs to be serviced, might lead the customer to make the purchase near home. But the most significant fact was that in all sizes of localities, the majority of washing machines were sold on installment credit.

The kind of store seemed to make no great difference in the proportion of washing machines sold on installment credit. Although some kinds of stores made a high percentage of their total sales on installment credit and others a low percentage, according to the findings of the Retail Credit Survey (table 4), all kinds of stores made approximately the same proportion of their washing-machine sales on installment credit.

TABLE 4. PERCENTAGE OF THE TOTAL SALES IN MIDDLE ATLANTIC STATES AND OF SALES OF WASHING MACHINES IN NEW YORK STATE, MADE ON INSTALLMENT CREDIT, ACCORDING TO KIND OF STORE, 1938

Kind of store	Middle Atlantic States*		New York State†	
	Number of stores	Per cent of total sales made on installment credit	Number of stores	Per cent of washing-machine sales made on installment credit
Department	38	10.3	27	85
Furniture	23	83.9	49	89
Hardware	25	1.2	43	80
Household appliance	7	64.6	129	79

*Adapted from Merriam (1939: 58, 74, 97, 111).
†Present study.

For those who wish to study further the extent of sales on installment credit, the following references are suggested:

MERRIAM, M. L. Retail credit survey, 1938. U. S. Commerce Dept., Domestic commerce ser. **109**: 3–179. 1939.

SELIGMAN, E. R. A. Economics of instalment selling. **1**: 92–119. 1927.

HOW INSTALLMENT SALES OF WASHING MACHINES ARE FINANCED

While it was stated earlier that there is only one source for credit in goods for consumers, retail stores, indirectly there are sometimes several agencies participating in this type of financing, because in an installment sale the seller does not receive complete payment for the article thus sold for some time; there is, therefore, the problem of financing this sale. The store itself may carry the contracts either out of its own cash resources or by obtaining a loan from a commercial bank under an established line of credit. In such a case, in a particular sale, only two contracting parties are involved either directly or indirectly, the buyer of the article and the seller. All subsequent arrangements will also involve only these two.

However, the store sometimes cannot afford to keep its capital tied up in negotiable paper, and does not have an established line of credit with a bank. It must then discount its installment paper with, or sell it to, a third party. Under such circumstances, three parties are involved in a particular transaction, the buyer, the seller, and the party taking the paper. Since the seller may have no other way of financing the sale, except with the aid of a third party, he will consult or follow the advice of the third party concerning acceptable buyers, at the beginning of the transaction. The third party may take an active part in the investigation of the credit standing of the customer and in the collection policy followed.

The dealer who carries his own installment contracts is in a position to make individual arrangements with his customers. He might be somewhat inclined to be lenient in these arrangements, since the particular transaction involved might be considered merely as one purchase in the total purchases of the customer. And expectations of future business might play an important part in his calculations. However, a third party, handling the contract, would probably be more interested in the particular transaction and less interested in the future purchases of the customer.

Of the agencies dealing in installment contracts, the finance companies handle the largest proportion. The history and functions of this type of agency have probably been most adequately described by Seligman.

Banks have entered into this type of business to some small extent in competition with the finance companies. In this study, two other agencies were also found to be dealing in installment contracts. One of these was a public-utility company. Such companies have been interested to a large extent in the sale of electric current, and the sale of electrical appliances increases the sale of such current. The utility companies have sometimes been inclined to be more anxious to place the electrical equipment in use than to make the most profitable sale. For this reason, they have occasionally extended terms considered too long and too lax by other sellers. On the other hand, the utility companies sometimes have felt that dealers were not pushing the sale of electrical equipment sufficiently. Therefore some conflict of interest has existed between these two groups. The action of one public-utility company in handling dealers' installment paper, as found in this study, may be an effort to prevent such conflict. The other case was of two merchants visited during this study who reported that some individual whom they preferred not to mention was discounting their contracts.

It was found that not only did several different agencies finance the sales of washing machines on installment credit, but that the same store might use several of these agencies. Various reasons were given for the use of two or more agencies. Some merchants said that they carried the contracts of their very good customers themselves. They wished to be in a position to treat these people as well as possible, sometimes making the finance charge less than that which would have been necessary if the contract had been carried by a finance company. Some merchants carried the accounts of customers who refused to purchase if the contract was to be handled by a finance company. One merchant said that he carried the contracts of those customers for whom he could not get a credit report satisfactory to the finance company, but whom he knew to be good risks. Several stores turned over to a finance company contracts of those customers with whom they had experienced difficulty in the past in regard to collections; these people, they said, would take advantage of the store but would make prompt payments to the finance company. Some stores carried all the contracts that they could, and then, when pressed for cash, turned some of them over to the finance company.

When the public-utility company financed the contracts, in some cases it was necessary for the store either to carry some of the contracts or to sell them elsewhere; the utility company handled only the contracts of those who were users of the utility company's service and had paid their bills satisfactorily for at least two years.

Merchants who used the facilities of both a bank and a finance company said that they sometimes found that they could finance contracts refused by the local bank, through a finance company. Also, the finance company sometimes gave more help in collecting accounts than did the bank.

The store itself did most of the financing. Fifty-two per cent of the value of the contracts was financed by the store alone, while only 13 per cent of the value of the contracts was handled by the finance company alone (table 5). Sixty-eight per cent of the stores financed at

TABLE 5. NUMBER OF STORES AND VALUE OF CONTRACTS, ACCORDING TO VARIOUS FINANCING AGENCIES USED
(266 stores, New York State, 1937–38)

Agency used	Number of stores		Value of contracts		Per cent of stores		Per cent of total value of contracts	
One agency:		178		$1,063,890		67		68
Store	98		$816,240		37		52	
Finance company	61		208,450		23		13	
Bank	12		24,080		4		2	
Other*	7		15,120		3		1	
Two agencies:		80		447,090		30		28
Store and finance company	57		314,260		22		20	
Store and other agency	17		113,280		6		7	
Finance company and other agency	6		19,550		2		1	
Three agencies:		8		53,670		3		4
Store and two other agencies	8		53,670		3		4	
Total		266		$1,564,650		100		100

*Public-utility company or other individual.

least some of their sales of washing machines themselves, and 62 per cent of the value of the contracts was handled by the store (table 6). The finance company was an agency used by 50 per cent of the stores, but only 29 per cent of the value of the contracts was handled by the finance company.

TABLE 6. PERCENTAGE OF STORES USING VARIOUS AGENCIES FOR FINANCING INSTALLMENT SALES OF WASHING MACHINES, AND VALUE OF CONTRACTS FINANCED BY THESE AGENCIES

(266 stores, New York State, 1937–38)

Financing agency	Per cent of stores*		Value of contracts		Per cent of total value of contracts	
Store, total:		68		$ 972,840		62
Store alone	37		$816,240		52	
Store and one other agency	28		147,350		9	
Store and two other agencies	3		9,250		1	
Finance company, total:		50		457,380		29
Finance company alone	23		208,450		13	
Finance company and one other agency	24		218,760		14	
Finance company and two other agencies	3		30,170		2	
Bank, total:		15		114,650		8
Bank alone	4		24,080		2	
Bank and one other agency	8		76,580		5	
Bank and two other agencies	3		13,990		1	
All other agencies		4		19,780		1
Total		....		$1,564,650		100

*No total can be stated since 80 stores financed their contracts through two agencies, and 8 stores financed their contracts through three agencies.

While the finance company handled only about one-fourth of the washing-machine installment contracts, it was participating in the financing done by one-half of the stores. Several merchants stated that they contemplated turning over to the finance company some of the contracts that they were handling themselves. It is therefore probable that the policies of the finance companies have wider influence than would be indicated by the actual amount of the contracts financed by them.

The stores located in the large cities handled a much larger percentage of the value of their contracts themselves than did the stores in the small localities, and the stores in the small localities financed a much larger percentage of their contracts through the finance companies than did the stores in the large cities (table 7).

TABLE 7. VALUE OF CONTRACTS, ACCORDING TO SIZE OF TOWN AND FINANCING AGENCY

(266 stores, New York State, 1937–38)

Population	Value of contracts financed by—				Per cent			
	Store	Finance company	Other agencies	All agencies	Store	Finance company	Other agencies	All agencies
Less than 4,950	$ 32,880	$ 50,350	$ 29,310	$ 112,540	29	45	26	100
4,950 to 19,949	148,850	103,690	31,320	283,860	52	36	12	100
19,950 to 49,949	224,090	159,170	14,610	397,870	56	40	4	100
49,950 and over	567,020	144,170	59,190	770,380	73	19	8	100
All stores	$972,840	$457,380	$134,430	$1,564,650	62	29	9	100

If more information is desired concerning agencies financing installment sales some helpful material may be found in:

[ANON.] Methods of financing installment sales of farm equipment, p. 1–18. Metropolitan Life Insurance Co., Policyholders Service Bur. 1935.

AYRES, M. V. The economic function of the sales finance company. Amer. Statis. Assoc. Journ. **33**: 59–70. 1938.

PLUMMER, L. A defense of automobile financing by banks. Time-sales financing **4**[4]: 7–8. 1939.

SELIGMAN, E. R. A. Economics of instalment selling, **1**: 33–91. 1927.

HOW THE CHARGE FOR INSTALLMENT CREDIT MAY BE STATED

One of the most confusing aspects of credit in goods is the difficulty of determining how much is being charged for the service. This is not limited merely to installment credit but is also true of open credit accounts. Some stores that say they do not make a charge for goods purchased on open account sometimes give a discount for cash. When the store does not make any difference between the cash and the credit price, the cash customer contributes toward the payment of the credit cost. Credit is a service; in some way the store that stays in business has to meet this cost just as it does its rent and payroll expense, and this cost must be reflected in the prices it receives for its goods.

While the charge for credit is usually not clearly expressed in open credit or charge accounts, it seems to be even more confusing in the purchase of goods on installment credit. There are two ways in which this charge can be confusing: in the method by which the price of the article is stated to the customer, and in the way in which the charge itself is quoted. In the study of washing machines, four ways were found in which the merchant quoted the price to a customer who was buying the machine on installment credit (table 8). He might tell the customer (1) what the price would be for cash, to which an extra amount would be added when the customer made his arrangements for an installment purchase; or (2) what the price would be if the article were bought on installment credit, in which case an amount might or might not be deducted if the customer paid cash; or (3) he might tell both the price

TABLE 8. METHODS USED BY STORES IN QUOTING THE PRICE FOR WASHING MACHINES SOLD ON INSTALLMENT CREDIT

(26,946 washing machines sold by 266 stores, New York State, 1937–38)

Method of quoting the price	Per cent of—	
	Stores	Washing machines sold
Cash price, with finance charge to be added	80	73
Installment price	9	10
Installment and cash price	5	9
List price*	6	8
Total	100	100

*In these cases a price was quoted; then, if the purchase were made on an installment basis, an additional amount was added to the quoted price, but a discount from this quoted price was given if the customer paid cash.

for a cash purchase and the price for an installment purchase; or (4) he might quote a list price to which was added an amount if the customer purchased on an installment plan or from which an amount was subtracted if the customer paid cash.

Actual examples of these four methods used by merchants in quoting the price were: (1) a machine was quoted at a cash price of $69.98 to which a finance charge was added, either in the form of a flat dollar charge, a specified number of periodic payments, or a percentage per year of the balance; (2) a machine was quoted at an installment price of $77.50; (3) a machine was quoted at a cash price of $79.95 and an installment price of $86.45; (4) a machine was quoted at a list price of $49.95 to which a finance charge of $5 was added, or from which a discount of 10 per cent was allowed if the customer paid cash.

Unlike the findings from some of the other studies that have been made, in this study a cash price was found to be most frequently quoted. It appears that nationally advertised articles, such as washing machines, whose prices may be fairly readily compared from store to store, are more likely to be quoted at a cash price to which a charge is added, than at an installment price from which a deduction may or may not be made if the customer pays cash. The cash price is the lower price, and the lower price is the best one for the merchant to quote when comparisons are possible. In the case of such articles as furniture where great and not easily detected differences in quality may exist, the price quoted is quite likely to be the installment one.

In addition to various ways of quoting the price, there are several different ways in which the charge for credit may be quoted. In this study, six different methods were found to be used, and some stores used two or more of these methods (table 9). Three of these methods accounted for about three-fourths of the sales; these were, the flat dollar charge, the percentage per year of the original unpaid balance, and the payment schedule. Two examples of the flat-dollar method of stating the charge were (1) that of a merchant who quoted a $7 charge on all $69.98 machines, and (2) that of a merchant who charged $5 for both a $79.50 washing machine and a $59.50 washing machine; the second method was illustrated by a merchant who quoted a cash price of $110, down-payment of $10, and a charge of 6 per cent per year of the original

TABLE 9. METHODS OF QUOTING THE CHARGE FOR INSTALLMENT CREDIT
(26,946 washing machines sold by 266 stores, New York State, 1937–38)

Method of quoting the charge	Per cent of—	
	Stores	Washing machines sold
No charge	2	1
Discount for cash	7	9
Discount for cash and other charge	6	8
Flat dollar charge	15	21
Percentage per year of the original unpaid balance after making down-payment	22	28
Payment-schedule charge	37	23
Percentage per year of the decreasing unpaid balance after making down-payment	2	2
Two or more methods	9	8
Total	100	100

unpaid balance, or $6; and an example of a payment schedule was a contract for $79.88, down-payment of $5, and 16 monthly installments of $4.68 each. The second of these three methods, was used by somewhat more stores than was the first, but it was not used by as many stores as was the third.

FLAT DOLLAR CHARGE

The flat dollar charge for credit is perhaps the simplest method for the merchant, but it is not so satisfactory for the customer, unless a much higher degree of standardization in installment selling practices than now exists is to be considered desirable. When such a charge is made, one of two policies may be followed. Either every customer purchasing a washing machine of a given price is expected to make the same down-payment and to complete the payments in the same length of time, the finance charge therefore being the same for all purchases at this price; or the merchant charges the same amount to all installment purchasers, regardless of the size of their down-payments, the price of the article purchased, or the length of time taken to pay for the article. According to the information presented later from this study, it appears that there is a good deal of variation in the amount of the initial payment that customers make, even when the price of the washing machine is the same; that is, that uniform payments at the beginning of the transaction are not now the customary procedure. When a flat dollar charge is made, the purchaser is not offered an inducement to complete his contract quickly, since fast and slow payers are charged the same amount.

PERCENTAGE PER YEAR OF THE UNPAID BALANCE

The method of expressing the credit charge as the percentage per year of the unpaid balance has been advocated by many merchants partly because it emphasizes to the customer the advantages of a larger down-payment and a shorter contract. If the customer knows that the size of the down-payment determines the balance on which the carrying charge is calculated, and that, therefore, the larger the down-payment, the smaller the carrying charge, and if he also sees that the sooner the payments are completed the smaller the carrying charge, he is more likely to make the largest possible down-payment and the periodic payments as few in number as possible. Certainly this method of quoting the charge helps to make this aspect of the situation clear for the buyer. It also shows what the allowance will be if payment is made ahead of the termination of the contract. None of the other methods of quoting the charge do this, and a variety of different allowances are made. It also makes clear what the charge will be if payments are not completed within the allotted time.

It has one possible disadvantage for the store, however. It is generally used for all types of sales, and a constant rate may not yield sufficient revenue on small purchases running for a short time to cover the cost of granting such credit, but may yield more than enough on the larger purchases. Stores have not fully analyzed their costs for the granting of credit and they do not know the extent of their installment sales of high-priced, long-term goods bringing sufficient revenue to cover the costs, and of low-priced, short-term goods that do not bring in sufficient revenue; this, however, is one aspect of the problem that is being given serious consideration at present.

Furthermore, this method has a rather serious disadvantage for the customer. The customer is likely to confuse a percentage per year on the original unpaid balance with an ordinary interest rate. Such an expression of the rate thus implies to the customer that the cost of the purchase on installment credit is much lower than is actually true. The customer who is comparing the cost of borrowing the money and paying cash for the purchase and the cost of purchasing on installment credit may be misled by this method of quoting the charge for an installment purchase. Even though there may be no intention to deceive in the mind of the merchants who use this method, it may, nevertheless, have this effect.

PAYMENT SCHEDULE

It was found in this study that the payment schedule was used by most stores that sold their paper to a finance company because the finance companies provided these schedules and wished the contracts that they bought to comply with these conditions. When these payment schedules are used, the allowance for the trade-in and the cash down-payment are subtracted from the quoted price (not always the lowest cash price that can be obtained, as previously pointed out, page 11, in those cases where a discount for cash is given); the amount thus obtained is "the balance". The monthly payments that the customer must make and the total amount of his payments, including the finance charge, may then be read from a table of calculations based on the amount of the balance and the length of time the customer wishes to take to pay the contract. The customer may not learn the amount he is paying for the credit privilege without a specific question on this point, especially if the seller tells him only the amount of each monthly payment and not the total amount. Both are usually entered on the installment contract, but since several merchants reported in this study that they had encountered difficulties with customers who had signed contracts and then found out that the amount remaining to be paid after they had made their down-payment, was greater than the cash price of the washing machine, it would appear that this point was not stressed sufficiently at the time of the sale. It was said that sometimes the salesman, in his eagerness to make the sale, failed to make clear to the customer the size of "the balance" plus the finance charge, and the difference between the cash price and the installment price. The fact that these payment schedules are usually in the salesman's hands and are not easily available to the customer for inspection may mean that the customer does not arrange his payments in the best possible fashion. When payment schedules are used, it is the salesman's responsibility to see that the customer makes the largest possible down-payment and pays the contract in the shortest possible time. If the customer does not see the advantage of such a procedure he may not be as cooperative as he would be otherwise. There was considerable comment from the merchants reporting in this study, to the effect that the salesmen in their anxiety to make the sale did not obtain as large a down-payment or as short a contract, as would have been possible.

Unfortunately the payment schedule does not provide any way of calculating the amount to be refunded if the contract is paid ahead of the due date.

The fact that the financing of the contracts has been done by many different agencies under different circumstances would account in part for the high degree of variation in the methods of stating the charge. As has been pointed out, not only did many stores with their own individual problems carry a large part of the contracts themselves, but several outside agencies, such as finance companies and banks, also participated in the financing. These all have their own ideas as to the methods that should be used. While the variety of the financing agencies through competition with each other has probably led to lower charges, it has also made the problem of standardization in the method of making the charge more difficult.

Since customers do not, as a general rule, make a standardized downpayment or complete their payments in the same length of time, the methods of expressing the charge should allow for these variations. Only two of the methods used by stores visited in this study meet this requirement: the percentage per month of the unpaid balance, and the payment schedule. The objection to the former is fundamental: since it has a tendency to cause the charge to appear low, it may be misleading when comparisons are made with charges made by other agencies of consumer credit that base their percentage rate not on the original unpaid balance but on the decreasing unpaid balance. The objections to the payment schedule are more capable of adjustment: the additional amount charged for the installment purchase needs to be more clearly presented, no calculations should be necessary to arrive at this figure, and these schedules should be more easily available to the customer for inspection and consideration. The refund to be given if the payments are completed before the due date should also be clearly stated.

PERCENTAGE PER YEAR OF THE DECREASING UNPAID BALANCE

No store visited in the study here reported was quoting the charge as a percentage per month or per year of the decreasing unpaid balance. The advantages of this method from the customer's point of view, as summarized by the Committee on Consumer Credit of the Commonwealth of Massachusetts, are quoted as follows:

1. Whenever goods are sold on deferred payment, the seller performs two separate functions; the sale of merchandise and the extension of credit for which a charge is made.
2. Whenever a charge is made for the extension of credit, this charge should be stated in terms which make it readily comparable with all other prices for the use-of-money repayable in monthly instalments.
3. The only accurate way to express the price of the use-of-money is by a given percentage on a given principal for a given time. Any other method of statement permits juggling with one of the two variables, principal and time.
4. In instalment credit, the outstanding amount of credit declines from month to month. Therefore the only accurate and outspoken way to express the charge for this type of credit is in terms of a given percentage on the current, unpaid monthly balance. (Report of Committee on Consumer Credit, 1936, page 25, footnote.)

To make such a quotation of the charge satisfactory for the purchaser, however, the amount of the additional charge for installment credit in dollars and cents should also be given. As will be shown later, the charge expressed in this manner is lower for the higher-priced washing machines (table 14, page 20), for which the contract runs for a longer period of time (table 17, page 22). The charge in dollars and cents in both these cases is higher, however. The purchaser who did not also know the charge in dollars and cents might thus be misled.

The chief objections to the use of the percentage per month of the decreasing unpaid balance method of quoting the charge from the merchant's point of view have been that such a quotation meant a percentage rate per year that was fairly high, and that the customer has been more interested in the dollar-and-cent cost than in the interest rate. It is certainly true that the average customer regards any interest rate above 6 or 8 per cent as exorbitant, and does not take into account the fact that costs of granting credit may differ. Even if the customer is more interested in the dollar-and-cent cost, as these merchants say, up to the present the cost has quite frequently not been presented in that manner.

If further study of this question is desired the following titles are suggested:

[Anonymous] Pricing retail instalment sales with or without the carrying charge, p. 1–19. Metropolitan Life Insurance Co., Policyholders Service Bur. 1933.

Committee on Consumer Credit (Massachusetts). Rept., p. 6–86. 1936.

INSTALLMENT CREDIT TERMS ON WHICH WASHING MACHINES ARE SOLD

In addition to supplying information concerning general practices in the sale of washing machines on installment credit, each merchant visited during this study was asked to select a contract for the sale of a washing machine on installment credit made to a customer and considered representative of such sales made by that store. The details of the sale were recorded and also any information that could be supplied concerning the purchaser. The following paragraphs are based on these contracts.

The average cash price of the washing machines purchased on these installment contracts was $77. This average was not very different from the $73.39 reported by *Business Week* as the average price of washing machines sold at retail (Anon., 1938: 31).

The average amount of the total initial payment made, when the customer bought the machine, or the amount that could be considered the customer's "equity" in the washing machine at the time of purchase, was $11. This item was the most variable of all terms of the contracts. This payment could be made in three ways: as a cash payment, the most common method used; as an allowance that the store gave on an old machine; or as a combination of both. Of the 310 persons who purchased washing machines, only 12 made no payment at all at the beginning of the transaction (table 10). The initial cash payment was, on the average, $9. Only 66 persons received a trade-in allowance, and of these only 27 made no payment in cash at the beginning of the purchase. The average amount received as an allowance by those persons who turned in their old ma-

TABLE 10. METHODS USED BY CUSTOMERS IN MAKING THE INITIAL PAYMENT FOR WASHING MACHINES SOLD ON INSTALLMENT CREDIT

(310 installment contracts for washing machines from 284 stores, New York State, 1937–38)

Method of making initial payment	Number of contracts
Cash down-payment only	232
Trade-in allowance only	27
Cash down-payment and trade-in allowance	39
No initial payment	12
Total	310

chines was $12. The payment made at the beginning of the transaction represented 15 per cent of the cash price, on the average: the cash down-payment was 12 per cent, and the trade-in allowance 3 per cent, of the cash price.

Three intervals during which payments could be made were found in this study. The majority of the purchasers, more than 80 per cent, made their payments monthly; about 15 per cent made their payments every week, and only 2 persons paid fortnightly.

In deciding which interval to use there were two problems that the merchant had to balance one against the other. To collect weekly or fortnightly would result in higher collection expenses; on the other hand, in such cases the loss from unpaid accounts would probably be less. Payments on the installment account could be arranged to coincide with the receipt of the purchaser's wages. In many cases, the installment creditor made a practice of cashing the installment purchaser's pay check. This had a double advantage for the merchant; it gave him information about the income of the purchaser and it insured prompt, periodic payments.

Finance companies did not, as a rule, take contracts that called for weekly collections. It happened in several cases, however, that contracts involving weekly collections were sold to a finance company, but in such cases the merchant made the weekly collections himself, and remitted to the finance company at the end of the month.

The contracts studied were divided fairly evenly into those in which the payments were completed in less than one year, in one year, and in more than one year. The shortest contract was for 4 months and the longest for 24 months. Those contracts that were to be paid in weekly installments ran, on the average, for 46 weeks, just slightly under one year; and those that were on a monthly basis ran, on the average, for 13 months, just over one year. One of the merchants interviewed said that it was his policy to arrange the payments on the weekly contracts in such a way that these contracts were completed within a year even if the purchaser missed one or two payments.

The average amount of the periodic payments made on all contracts was $5.09. Since the payments could be made weekly, fortnightly, or monthly, the average for all payments did not give a wholly true picture. The small payments tended to be on those contracts that had the shorter payment interval. The variation in the payments made was rather small. The amount of the payment seemed to concentrate at certain figures. For example, a little less than half of the monthly contracts called for payment of from $4.45 to $5.44 per month, and about the same proportion of the weekly contracts called for a payment of $1.00 a week (table 11). It would appear that while people vary rather widely in the amount that they pay at the beginning of the transaction, there is much less variation in the amount they pay periodically, even taking price into consideration (table 14, page 20).

TABLE 11. DISTRIBUTION OF CONTRACTS ACCORDING TO INTERVAL AND AMOUNT OF PERIODIC PAYMENT

(310 installment contracts for washing machines from 284 stores in New York State, 1937–38)

Interval and amount of periodic payment	Number of contracts	Per cent
Month:	259	100
Less than $4.45	33	13
$4.45 to $5.44	119	46
$5.45 to $6.44	49	19
$6.45 and over	58	22
Week:	49	100
$1.00	20	41
$1.01 to $1.50	14	28
$1.51 and over*	15	31
Fortnight:	2	100
$2.00	2	100

*Highest periodic payment was $3.00.

If a comparison is made between a loan and an installment purchase, the finance charge may be considered as the amount of interest that is paid. In the cases studied, this amounted on the average to $7.26. In eight cases no finance charge was made.

If the finance charge is considered as the amount of interest, then the rate of interest paid may be calculated. This rate of interest is called the cost-rate in this study, and corresponds to the expression of the charge as a percentage per year on the decreasing unpaid balance. The cost-rate was not given in any of the cases studied, but was calculated from other data given in the records. It is a calculation which calls for the use of arithmetic but which is possible for all purchasers to make for themselves.

Several points must be kept in mind when such a calculation is made, however. In the first place, there has been considerable objection on the part of merchants and finance companies to the designation of the carrying charge as *interest* because, it is said, this charge covers not only what would ordinarily be considered interest, but also the cost of investigation, the cost of putting the account on the books, the cost of collecting the periodic payments, and the losses that might result from repossessions. Also, while the balance of the cash price remaining after the initial payment has been made, which in the cases studied averaged $65, could be considered as the principal of a loan, this would be the principal only until the first periodic payment was made, at which time the principal would be reduced. Since each periodic payment on an installment purchase is usually considered as composed partly of payment on the interest and partly of payment on the principal, the principal is reduced with each payment. The balance existing at the beginning of the transaction, therefore, is the principal only at one period and is much larger than the average principal for the whole life of the loan. There is no way of knowing, however, from most installment contracts just how much reduction takes place in the principal with each payment, for the usual installment contract does not designate what proportion of each payment is to be considered as interest and what proportion as a reduction of the principal.

In this study, an equivalent interest rate, or cost-rate, was calculated from the two formulae:[2]

$$r = \frac{2mI}{B(n+1)}$$ Used when all payments were equal

and

$$r = \frac{2mI(B+I)}{Bn(B+I+z)}$$ Used when the last payment was not the same as the other payments

These formulae assume that each payment contains the same proportion of principal and interest. While several other methods could have been used, this method, sometimes called the "constant ratio" method, is the simplest to calculate, and has been most widely used in the other studies that have been made.

The average cost rate obtained by these formulae in the contracts studied was 20 per cent. In many stores if the payments on a purchase were completed in 30, 60, or 90 days, only the cash price was charged; no finance charge was added. This might be done in the case of open book accounts, or, if the installment purchaser paid cash within this period, any finance charge previously paid on the purchase might be refunded. In such cases, it might be considered that the installment customer paid the additional charge for the credit privilege, not for the whole duration of the contract, but only for the time that the contract ran beyond the free-credit period. This, of course, would shorten the length of the period for which the credit was granted, and therefore increase the cost-rate. In the case of the contracts studied, when the cost-rate was adjusted for this free-credit period, it was 26 per cent, on the average.

In the majority of the contracts studied, it was said by the merchant that some refund of the finance charge would be made if the customer completed his payments ahead of the time required by the contract. In 50 per cent of the contracts, however, the store simply stated that some refund would be made, and in only 26 per cent of the cases was this refund specific; that is, it was stated that a definite percentage or amount of the finance charge would be refunded if the contract was paid in advance of the due date (table 12). As has been pointed out in the discussion of methods of quoting the charge, it is difficult for the customer to know how much refund will be made.

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[2] The following is an explanation of the terms in the formulae:

r, rate per year expressed as a decimal fraction
m, number of payment periods in one year. (For monthly payments, "m" is 12; for weekly payments "m" is 52; etc.)
I, total carrying charge or interest in dollars
B, unpaid balance at the beginning of the credit period (cash price less the total original payment, if any)
n, number of payments called for in the credit terms, not counting the down-payment
z, the last payment in dollars in cases where it differs from the other payments.

TABLE 12. PERCENTAGE DISTRIBUTION OF CONTRACTS ACCORDING TO REFUND ARRANGEMENTS IF PAYMENTS WERE COMPLETED BEFORE DUE DATE
(310 installment contracts for washing machines from 284 stores in New York State, 1937–38)

Refund arrangement	Per cent of contracts
No refund made	8
Refund made only if contract completed within first 30 to 90 days	11
Some refund made, but no specific amount mentioned	50
Exact refund made	26
Store had no information since arrangements must be made with another party	5
Total	100

It was stated in connection with the majority of the contracts studied, that no charge was made if the customer failed to make his payment at the date due (table 13). However, in 15 per cent of the cases a charge was made even if payment was made less than one month after the due date. This charge was usually made, however, in the guise of a discount which was given if the payment was made promptly, and a few days of grace were allowed. In 21 per cent of the contracts a charge was levied if the customer delayed for a month or more; in 5 per cent of these cases, however, the charge was made only if the failure to pay caused the contract to run over the original time. That is, if payments were not made for two months, but on the third month all payments were brought up to date, and the contract completely paid at the termination date, no charge would be made. However, a customer might make no payments for two months, but on the third month resume his regular payment; in this case, at the original date of termination the contract would be extended for two months, and an additional charge made for this extension. In 10 per cent of the contracts the merchants said that the conditions causing the failure to make the payment would determine whether or not a charge would be levied.

TABLE 13. PERCENTAGE DISTRIBUTION OF CONTRACTS ACCORDING TO PENALTY FOR DELAY IN PAYMENTS
(308 installment contracts for washing machines from 282 stores in New York State, 1937–38)

Penalty	Per cent of contracts
No penalty	52
Penalty, if payment delayed for period of less than one month	15
Penalty, if payment delayed for period of one month	11
Penalty, varied with customer and conditions	10
Extra charge added, if contract extended over the contract period	5
Penalty, if payment delayed for period of more than one month	5
Charge levied by agency other than store, and store had no information	2
Total	100

CAUSES OF SOME OF THE VARIATIONS IN THESE TERMS

As has been pointed out in the preceding section, there was considerable variation in all terms of the contracts. An attempt was made to see how these variations affected the other terms of the contracts. Four factors that could well have had some effect on the other terms are: the original price, in cash, of the washing machine purchased; the balance remaining to be paid after the original payments had been made; the length of time taken to complete the payments; and the interval in which payments were made.

Those persons who purchased a high-priced washing machine not only made a larger initial payment than did those who purchased a low-priced one, but this initial payment represented a larger percentage of the cash price (table 14). However, those persons who purchased a high-priced machine did not make much larger periodic payments, nor were these payments larger in relation to the balance remaining to be paid, than those made by the purchasers of a low-priced washing machine. In other words, those persons who purchased high-priced machines took a longer time to pay the contracts than did those who purchased low-priced machines, although from their initial payments it would appear that the former were in a position to pay more quickly for their purchases.

TABLE 14. CASH PRICE OF THE WASHING MACHINES, AND OTHER TERMS OF THE CONTRACTS

(310 installment contracts for washing machines from 284 stores in New York State, 1937–38)

Cash price of washing machine purchased	Number of contracts	Average initial payment	Per cent initial payment was of cash price	Average length of contract		Average periodic payment	Per cent periodic payment was of balance remaining	Average finance charge	Average cost-rate (per cent)
				Weeks	Months				
Less than $60....	64	$ 6	12	43	11	$3.50	8	$ 4.85	26
$60 to $79.......	129	9	13	47	12	4.85	8	6.07	21
$80 to $99.......	65	12	15	51	15	5.57	8	7.58	17
$100 and over....	52	23	19	47	17	7.06	7	12.76	17
All contracts....	310	$11	15	46	13	$5.09	8	$ 7.26	20

Those persons who bought the high-priced washing machine paid, on the average, a higher finance charge, although they paid a lower cost-rate. This point is worthy of emphasis, for if the charge were quoted as a percentage per year of the decreasing unpaid balance, unscrupulous sellers might not tell the customer the amount of the finance charge, but only state to them the fact that the rate on the higher-priced article was smaller. Thus if the cost-rate is stated, the amount of the finance charge must also be given in order that the cost-rate alone may not be misleading to the unwary.

Changes in the balance of the cash price remaining to be paid had about the same effect on the other terms of the contract as did changes in the cash price itself. Those persons who had a large balance remaining to be paid after their initial payments, made slightly larger periodic payments, took a somewhat longer time to pay the contract, and paid a larger finance charge but a lower cost-rate, than did those who had a small balance remaining to be paid (table 15). Here again the opposite movements of the finance charge and the cost-rate should be emphasized.

Purchasers should understand clearly that a low cost-rate is frequently not accompanied by a low finance charge. This is due to the fact that certain costs of credit, such as cost of investigation and of putting the account on the books, are fixed, and therefore the same for a $10 purchase as

TABLE 15. BALANCE OF CASH PRICE REMAINING AFTER INITIAL PAYMENT, AND OTHER TERMS OF THE CONTRACTS
(310 installment contracts for washing machines from 284 stores in New York State, 1937–38)

Balance of cash price remaining after initial payment	Number of contracts	Average periodic payment		Average length of contract		Average finance charge	Average cost-rate (per cent)
		Weekly	Monthly	Weeks	Months		
Less than $50	63	$1.44	$4.70	38	11	$ 4.84	28
$50 to $59	76	1.24	5.14	50	12	5.69	20
$60 to $69	71	1.47	5.87	50	13	6.42	19
$70 to $79	39	1.65	6.49	53	13	7.51	17
$80 and over	61	2.00	6.90	50	18	12.52	17
All contracts	310	$1.45	$5.81	46	13	$ 7.26	20

for a $100 purchase, and the same for a 6-month as for a 2-year contract. The rate on a $10 purchase must be higher to yield an amount sufficient to cover these costs, than on a $100 purchase. If and when stores make a more serious effort to arrange their charges according to the cost of handling accounts of different amounts, the cost-rate would probably be less for the larger amounts and contracts that run for a longer time than for small amounts and short-term contracts. However, the amount of the charge for the longer contracts would still be larger than the amount of the charge for the short-term contracts. It would then be even more important than it is now for purchasers to know both the amount and the rate of the charge. This same principle is illustrated in the "step"-rates used by the small loan companies; in this State the rate for loans of more than $150 is less than the rate for loans of less than $150.

Those persons who paid for their washing machine every week, purchased, on the average, a lower-priced article than did those persons who paid every month (table 16). When the payments were made weekly, the average initial payment and also the percentage of the cash price that this payment represented were lower than in the cases where monthly payments were made. The finance charge was lower and the cost-rate higher in the weekly contracts. It was not surprising that the cost-rate was higher, in as much as the weekly contracts would involve more labor in handling. This is a case in which it might be to the purchaser's advantage to know that the rate was higher, although the merchant probably preferred to have the account on a weekly basis.

TABLE 16. INTERVAL OF PAYMENT, AND OTHER TERMS OF THE CONTRACTS
(310 installment contracts for washing machines from 284 stores in New York State, 1937–38)

Interval of payment	Number of contracts	Average cash price	Average initial payment	Per cent initial payment was of cash price	Average finance charge	Average cost-rate (per cent)
Week	49	$63	$ 7	11	$5.03	24
Fortnight	2	64	5	8	3.00	9
Month	259	79	12	16	7.71	20
All contracts	310	$77	$11	15	$7.26	20

Those contracts that ran for the longest period of time covered washing machines of a higher average price than did those that ran for a shorter time (table 17). When the contracts ran for a long period of time, the purchasers did not seem, on the average, to make much larger initial payments, and these payments represented a smaller percentage of the cash price, than in the case of contracts that ran for a short period of time. The contracts running for a short period of time called for larger amounts to be paid periodically than did those contracts that ran for a long period of time. Apparently those persons who planned to pay for their contracts in a short period of time bought a washing machine at a lower-than-average price, made a fairly substantial initial payment on it, which payment represented a larger-than-average percentage of the cash price, and made larger-than-average periodic payments. These persons paid a lower-than-average finance charge, but a higher-than-average cost-rate. This is another case in which the cost-rate alone might be misleading to the customer who did not understand the meaning of the two ways of expressing the cost of credit.

TABLE 17. LENGTH OF CONTRACTS, AND OTHER TERMS OF THE CONTRACTS
(310 installment contracts for washing machines from 284 stores in New York State, 1937–38)

Length of contract	Number of contracts	Average cash price	Average initial payment	Per cent initial payment was of cash price	Average periodic payment		Average finance charge	Average cost-rate (per cent)
					Weekly	Monthly		
Less than one year..	91	$64	$11	18	$1.61	$6.82	$ 4.59	24
One year..........	113	74	11	15	1.17	5.82	6.60	20
Over one year......	106	90	12	14	1.14	5.13	10.25	17
All contracts.......	310	$77	$11	15	$1.45	$5.81	$ 7.26	20

For those interested in the question of terms, the following are suggested:

FITZPATRICK, F. J. Installment selling by department stores during 1938. National Retail Dry Goods Assoc., Credit Management Div. Yearbook **6**: 45–53. 1939.

FOSTER, LEB. R. Instalment credit costs and the consumer. Univ. of Chicago. Journ. of bus. **8**: 27–45. 1935.

FROMAN, L. A. The cost of installment buying. Harvard bus. rev. **11**: 227–236. 1933.

MERRIAM, M. L. The trend of installment terms, December 1936–37, p. 1–30. U. S. Commerce Dept. Mimeo. rept. March 4, 1938.

PLUMMER, W. C. Social and economic consequences of buying on the installment plan. Amer. Acad. of Polit. and Soc. Sci. Ann. **129** (sup.): 1–57. 1927.

OCCUPATION AND INCOME OF THE PURCHASERS OF WASHING MACHINES ON INSTALLMENT CREDIT

Information concerning the income and occupation of the purchasers whose contracts were studied was obtained from records that the stores had and with no identification of the persons. Many of the stores did not supply such information, sometimes because they could not, and sometimes because they did not wish to divulge information about their customers. Since these data represent only what the store knew of the customer, they may not, of course, be complete or accurate, but if incomes and occupations have any influence on the procedures of the store, this would be the information that was used. The persons for whom incomes were given were not always the same ones for whom occupations also were given.

Almost half of the purchasers for whom occupations were reported were unskilled workers (table 18). These purchasers bought a washing machine of a slightly lower than average price. They also made the lowest initial payment of all groups of purchasers, and this represented the smallest percentage of the cash price. These purchasers also made smaller-than-average periodic payments and paid smaller-than-average finance charges. The occupation of the purchaser did not seem to make any difference in the cost-rate that was paid.

TABLE 18. Occupations of Purchasers and Terms of Their Contracts
(258 installment contracts for washing machines from 238 stores in New York State, 1937–38)

Occupation of purchasers	Number of contracts	Average cash price	Average initial payment	Per cent initial payment was of cash price	Average periodic payment	Average finance charge	Average cost-rate (per cent)
W. P. A. workers	2	$61	$13	20	$3.00	$6.50	27
Unskilled workers	128	71	10	13	4.58	6.75	20
Skilled workers	43	79	14	18	5.24	7.59	20
Clerical workers, salespersons, and guards	26	88	13	15	4.85	8.50	19
Business of own, and retired	39	80	12	15	6.11	8.01	21
Supervisory, semi-professional, and professional workers	20	87	18	20	6.35	7.56	19
All contracts	258	$77	$12	15	$5.07	$7.32	20

It was reasonably clear that income had some influence on the price that was paid for a washing machine (table 19). All the payments that were made by those with the lowest incomes were the lowest payments made: the initial payment, and the percentage that this represented of the

TABLE 19. Incomes of Purchasers and Terms of Their Contracts
(198 installment contracts for washing machines from 182 stores in New York State, 1937–38)

Income of purchasers	Number of contracts	Average cash price	Average initial payment	Per cent initial payment was of cash price	Average periodic payment	Average finance charge	Average cost-rate (per cent)
Less than $1,050	53	$67	$ 8	12	$4.49	$6.11	21
$1,050 to $1,549	75	78	10	13	5.12	8.48	21
$1,550 to $2,049	52	84	13	16	4.95	7.05	16
$2,050 and over	18	82	17	20	6.07	7.45	19
All contracts	198	$77	$11	14	$4.99	$7.37	20

cash price, the periodic payment, and the finance charge. The initial payment was noticeably lower for those with low incomes, while in the periodic payments there was little difference. However, those purchasers who had the lowest incomes paid a somewhat larger cost-rate than did those with higher incomes. It would appear from these figures that either the stores were exercising some caution in regard to the price of washing machines that were sold to persons with low incomes, or those persons were careful on their own account.

A few studies exist concerning persons who purchase on installment credit, among which are the following:

[ANON.] Cost of living of federal employees in five cities; installment buying. Monthly lab. rev. **29**: 1039–1048. 1929.

EUBANK, E. E. A case study of the effects of consumer credit upon the family. Amer. Acad. of Polit. and Soc. Sci. Ann. **196**: 211–220. 1938.

SADD, V., AND WILLIAMS, R. T. Causes of bankruptcies among consumers. U. S. Commerce Dept. Domestic commerce ser. **82**: 1–37. 1933.

YOUNG, R. A., AND BERNSTEIN, B. The statistical pattern of installment debt. National Bur. Econ. Res. Buls. **76** and **77**. 1939.

HOW THE CUSTOMER'S CREDIT STANDING IS INVESTIGATED

Credit investigation is usually thought of as a protective measure taken by the store for its own benefit. This, of course, is true, but the benefit of this investigation also accrues to the purchaser to some extent. Repossessions in general represent a loss, both to the merchant and to the purchaser, as well as to all customers. From its accumulated knowledge of what past purchasers have been able to pay for, and from its present knowledge of the income and other commitments of the purchaser, the store can probably foretell fairly well those customers who will not be able to make their payments. Therefore, any effort that the stores make to prevent these people from undertaking such obligations may be beneficial to all customers, especially to those who are inclined to be overly optimistic about their ability to pay for their purchases on installment credit.

Only three merchants said that they made no effort to investigate the credit standing of their customers (table 20). These three said that they followed a very strict collection policy. They did not check the credit, but unless the account was paid promptly the store repossessed the article at once.

About 60 per cent of the stores conducted at least some of their credit investigation through a credit bureau. Credit-bureau service, however, was not available in most small localities. In such places, there existed some resentment toward credit bureaus since, it was said, those in neighboring cities frequently called for information about customers living in the small locality but making some purchase in the larger city, and the local store received no compensation or return for such service. Credit bureaus, however, probably supply the most satisfactory method of making investigations, since through them the available information about other credit purchases of customers may be pooled. This may

TABLE 20. TYPES OF INVESTIGATION OF CREDIT STANDING OF CUSTOMERS
(266 stores, New York State, 1937–38)

Type of investigation	Number of–		Per cent	
	Stores	Washing machines sold	Stores	Washing machines sold
None	3	63	1	*
Through credit bureau	113	18,162	43	67
Through an outside agency other than credit bureau	64	3,601	24	13
Through credit bureau and other outside agency	48	3,091	18	12
By store only	38	2,029	14	8
Total	266	26,946	100	100

*Less than 0.5 per cent.

prevent customers from being over-sold even if they are inclined to overbuy on installment credit.

In 64 stores, or 24 per cent of those visited, the merchants said that the investigation was done by some outside agency other than the credit bureau, an agency that might also be financing the contracts. This might be a bank, a finance company, or a public-utility company.

Where the public-utility company made the investigation, it was usually only an inquiry as to whether the customer had been a user of current on its lines for two years, and whether he had paid his bills satisfactorily during this period. It may be that while the installment purchase and the charge for current are billed separately, the customer does not think of them separately, and is inclined to believe that if payments on the installment purchase are not made promptly the current will be cut off. Payments may be made more promptly for this reason. The investigation carried on by other outside agencies apparently varied considerably but not a great deal of information on this subject could be gathered from the stores.

Forty-eight, or 18 per cent, of the stores made part of their investigations through a credit bureau and part through some other outside agency. Thirty-eight, or 14 per cent, of the stores relied solely on their own credit investigation. This investigation varied widely both in scope and method. In some cases, where the merchant was well acquainted with the neighborhood, he would merely ask for the customer's name and address. If the address seemed satisfactory, that was sufficient. Some stores called other larger stores in town; some asked for references and called these. There was a difference of opinion among merchants as to the value of investigations which they carried on themselves. Some said that they had been so long established that they knew everyone, or could easily find out about them. Others said that they had difficulty in obtaining information; references did not help, they said, because people usually kept some good references for use in such cases. Stores that carried on their own investigations were generally located in small towns, probably partly because credit-bureau service was not available there, and partly because the merchants themselves felt more capable of assessing the credit standing of the purchaser (table 21). Only five per cent of the stores located in towns of a population of less than 4950, however, had credit departments of their own (table 22).

TABLE 21. DISTRIBUTION OF STORES ACCORDING TO SIZE OF TOWN AND TYPE OF INVESTIGATION OF CREDIT STANDING OF CUSTOMER
(266 stores, New York State, 1937–38)

Population	Type of investigation									
	None	Through credit bureau	Through an outoutside agency other than credit bureau	Through a credit bureau and other outside agency	By store only	None	Through credit bureau	Through an outoutside agency other than credit bureau	Through a credit bureau and other outside agency	By store only
	Number of stores					Per cent				
Less than 4,950...	1	4	24	6	24	33	4	37	12	63
4,950 to 19,949..	.	35	18	18	5	..	31	28	38	13
19,950 to 49,949..	1	35	5	13	2	33	31	8	27	5
49,950 and over....	1	39	17	11	7	33	34	27	23	19
Total.....	3	113	64	48	38	99	100	100	100	100

One aspect of credit investigation that seemed to the writer to need serious consideration was the question of the customer who was able to pay for the article in question, but who was not able to pay for that article and two or three others. This point has been brought out by others who have studied the matter (Sadd and Williams, 1933; Schmalz, 1938; Foster, 1937; Committee on Consumer Credit, 1936). It was particularly emphasized by one merchant visited during this study. He said that he had sold a washing machine to a customer who had later tried to purchase a stove on installment credit before he had completed his payments on the washing machine. This particular merchant refused to sell him the second article, knowing that the customer would have difficulty in paying for both purchases at the same time. The customer went elsewhere and made his purchase. The result was that payments were not made on either piece of equipment, and both were finally repossessed. The merchant, in recounting this experience, was not certain that had the second seller known of the customer's previous commitments, he would have refused to make the sale; but he thought that if he himself had

TABLE 22. PERCENTAGE DISTRIBUTION OF STORES ACCORDING TO SIZE OF TOWN AND PRESENCE OF CREDIT DEPARTMENT
(266 stores, New York State, 1937–38)

Population	Number of stores	Per cent		
		With credit department	With no credit department	All stores
Less than 4,950....................	59	5	95	100
4,950 to 19,949....................	76	22	78	100
19,950 to 49,949....................	56	59	41	100
49,950 and over....................	75	41	59	100
All stores........................	266	32	68	100

known of the second purchase of the customer he would have watched the account more closely. The fact that another purchase had been made on installment credit, and that payments could not be maintained on both the articles, was cited several times by merchants as the reason for a repossession. (Appendix, page 34.)

One of the possible ways of keeping track of these different commitments is through the filing of contracts as specified by the New York State Uniform Conditional Sales Law.[3] Contracts are filed for the protection of persons, who may later become creditors, against previous liens, and also to prevent difficulty for the installment sellers if liens should be made against the purchasers. It was found in this study that contracts generally were filed only if some question about the customer's credit standing existed in the mind of the seller. The merchant, for instance, may have doubted the customer's ability to pay in the beginning;[4] the customer may have come from out of town, a circumstance that always raised suspicion in the merchant's mind, since the customer's credit rating in his home town might have been too poor for any merchant there to undertake the risk of selling to him on credit; the purchase may have involved so large a sum of money that the merchant felt it necessary to protect himself in all possible ways; or circumstances such as a threatened strike in his place of employment might make the customer's future financial position somewhat questionable. About one-fourth of the merchants always filed their contracts, and about the same proportion never filed their contracts; about 40 per cent of the merchants occasionally filed them for the reasons given earlier (table 23).

TABLE 23. POLICY IN REGARD TO FILING INSTALLMENT CONTRACTS FOR WASHING MACHINES
(266 stores, New York State, 1937–38)

Policy in regard to filing	Number of–		Per cent	
	Stores	Washing machines sold	Stores	Washing machines sold
Filing done by others; store did not know whether contracts were filed or not	9	513	3	2
All contracts filed	73	7,346	28	27
No contracts filed	75	8,024	28	30
Some contracts filed	109	11,063	41	41
Total	266	26,946	100	100

The chief reasons given for not filing the contracts, or filing only some of them, were that the customer did not desire to have his business made common property; that some customers refused to purchase if the contracts were to be filed; that there was some cost involved in filing; and that filing was something of an effort. The anxiety of the merchant to respect the customer's secretiveness in financial matters works strongly against the need of the credit grantor for adequate information, both for his and the customer's protection. The merchant cannot be blamed greatly for this situation, however, as he can hardly be expected to make a move that he feels would incur the hostility of his customers. It should be pointed out, nevertheless, that the present policy of filing only those contracts in which there is some doubt about the customer's ability to pay would certainly be one reason for customer resentment of this practice.

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[3] Article 4 of the Personal Property Law.

[4] While making sales to doubtful customers is not a practice that can be approved by those interested in the welfare of the customer, it does occur. It might be well for merchants who do this to note the frequency with which it is implied, at least, in the reasons for repossessions, that the merchant was somewhat at fault in granting the credit (page 34).

Further information about credit investigation made by stores may be found in:

BOWERS, W. A. Furniture distribution in the Gulf Southwest. U. S. Commerce Dept. Domestic commerce ser. **76**: 117–120. 1932.

PHELPS, C. W. Controlled installment credit, p. 1–43. Household Finance Corp. 1938.

Yearbooks of the Credit Management Division, National Retail Dry Goods Association.

Articles of this nature are generally written from the point of view of preventing losses to the store, but the bearing this has on the customer's problems may be easily discerned.

EXTENT OF REPOSSESSIONS OF WASHING MACHINES

Information about repossessions were gathered in two ways in this study. In the first place, the store was asked to report the number of repossessions of washing machines that were made during the past year. In addition to this, the store was asked to give more complete information about one repossession that had been made. Seventy-three records of these repossessions were obtained from 70 stores.

Numbers of reposessions are one of the ways in which a check can be made on whether the granting of credit is carried on in a manner satisfactory both from the consumer's and the store's point of view. In this study, it was found that, on the average, 1.3 washing machines were repossessed out of every 100 sales that were made, and 1.6 washing machines were repossessed out of every 100 sales that were made on installment credit.

In studying these repossessions, several qualifications must be kept in mind. In the first place, a washing machine is an article that is not frequently repossessed. The nature of the article means that it is usually purchased by a person in a fairly permanent location, generally by a member of a family group. Such persons are generally considered good credit risks. A washing machine is an article that is not changed often in style or model. As was emphasized by many merchants, the figures on repossessions for this article would be much lower than those on radios, for example, where the style element and yearly changes of model, with the subsequent drop in the price of the past year's model, make the installment purchaser unwilling to continue payments on an article that could be purchased at a much lower price. In general, the families purchasing washing machines were from an economic group subject to many hazards in employment. A threatened strike in one area curtailed sales of washing machines. In another locality, the merchants had been forced to carry their installment customers through a strike of eleven week's duration.

In interpreting these data, it must also be kept in mind that not all repossessions may be accounted for. Some few stores were financing their installment contracts on a non-recourse or limited-recourse basis. In such cases, the outside financing agency might have made some repossessions that were not reported by the store, although most of the stores reported that they preferred to repurchase the repossessed article in order to have control over the secondhand sales of this article.

The fact that repossessions were small in number still might not represent a completely satisfactory situation from the customer's point of view. In several instances, the merchants said that their chief problem was to avoid making the repossessions that were possible. A customer sometimes would regret a purchase and desire to end his obligation by allowing the machine to revert to the store. Such action is probably due in part to the customer's lack of understanding of the terms of the contract before the purchase was made. Since it was usually more profitable for the store to have the payments completed, considerable effort was exerted to prevent repossession when the customer could continue the payments. In the future, if stores should engage in installment sales of articles that have little repossession value, this problem will probably become more acute.

Repossessions were slightly larger in small towns than they were in the large centers (table 24). This was rather surprising as it might be thought that there would be more reluctance on the part of the stores to repossess where the fact would be widely known to the customers. Two reasons may account for this fact. In the small towns, the finance companies were handling a larger percentage of the contracts than in the larger centers, and the rate of repossessions was greater for the finance companies (table 25). This might be expected since, as was pointed out earlier, the finance company does not have the intimate and continuing relationship with the purchaser that the merchant has, and in addition, there was also some tendency for the merchants to turn the poorer contracts over to the finance companies, or perhaps it might be better to say, that they kept the best contracts for themselves. The other fact that might account for the larger number of repossessions in the small centers was the investigation that was done in them: the credit investigation was less standardized, fewer stores had their own credit departments, and the use of the services of credit bureaus was not

TABLE 24. NUMBER OF REPOSSESSIONS OF WASHING MACHINES SOLD ON INSTALLMENT CREDIT, ACCORDING TO SIZE OF TOWN
(262 stores, New York State, 1937–38)

Population	Number of stores	Number of repossessions	
		Per 100 sales	Per 100 sales on installment credit
Less than 4,950	59	1.9	2.6
4,950 to 19,949	75	2.2	2.8
19,950 to 49,949	56	1.5	1.9
49,950 and over	72	0.8	0.9
All stores	262	1.3	1.6

TABLE 25. NUMBER OF REPOSSESSIONS OF WASHING MACHINES SOLD ON INSTALLMENT CREDIT, ACCORDING TO FINANCING AGENCY
(262 stores, New York State, 1937–38)

Financing agency	Number of stores	Number of repossessions	
		Per 100 sales	Per 100 sales on installment credit
Store, alone	95	0.8	0.9
Store and one other agency	73	1.5	1.9
Store and two other agencies	8	2.9	3.5
Finance company, alone	61	2.4	3.1
Finance company and one other agency	63	1.9	2.4
Finance company and two other agencies	8	2.9	3.5
Single agency other than store or finance company	19	1.2	1.4

possible in some cases. Both of these latter methods of credit investigation appeared to keep repossessions lower than the average (tables 26 and 27).

TABLE 26. NUMBER OF REPOSSESSIONS OF WASHING MACHINES SOLD ON INSTALLMENT CREDIT, ACCORDING TO PRESENCE OF CREDIT DEPARTMENT IN THE STORE
(262 stores, New York State, 1937–38)

Presence of credit department	Number of stores	Number of repossessions	
		Per 100 sales	Per 100 sales on installment credit
No credit department in store	182	1.8	2.2
Credit department in store	80	1.0	1.2

TABLE 27. NUMBER OF REPOSSESSIONS OF WASHING MACHINES SOLD ON INSTALLMENT CREDIT, ACCORDING TO TYPE OF INVESTIGATION OF THE CREDIT STANDING OF THE CUSTOMER
(262 stores, New York State, 1937–38)

Type of investigation	Number of stores	Number of repossessions	
		Per 100 sales	Per 100 sales on installment credit
None	3	3.2	3.3
Through credit bureau	111	1.1	1.3
Through outside agency other than credit bureau	64	1.8	2.5
Through a credit bureau and other outside agency	48	2.1	2.6
By store only	36	1.5	1.8
All stores	262	1.3	1.6

From those 73 records of actual repossessions obtained, the average amount that the customer had agreed to pay was $85.68, and of this amount, $28.45 was paid, or about one-third of the amount that the customer had contracted to pay. This information was obtained by asking the merchant about the repossession, and perhaps it was naturally somewhat biased. The merchants stated in several instances, however, that their own laxness was to blame for repossessions (Appendix, page 34). In 41, or more than half, of the cases, conditions out of the control of either the store or the customer, caused the customer to discontinue the payments, and caused the machine to revert to the store. Unemployment was the most important of these reasons. Family conditions such as illness, death, or marital difficulties were also important causes for repossessions. Frequently overbuying was at least a contributing cause for repossession. In many of the cases, it was apparent that had more consideration been given to the purchaser's general situation, the sale never would have been made. Unless either the buyer or the seller were profiting by these repossessions, it would appear that further investigation would have been advantageous to both.

It would also appear that the stores in general were not anxious to make these repossessions, since, on the average, it was stated that three and one half months were allowed to lapse after the last payment was made before the machine was brought back to the store.

The subject of repossessions may be studied in:

New York State Uniform Conditional Sales Law, Article 4 of the Personal Property Law, sections 76 to 80.

SELIGMAN, E. R. A. Economics of instalment selling, 2:477–520. 1927.

CONCLUSIONS

Sales of washing machines are most frequently made on installment credit, and therefore policies and practices in this type of sale have significance for both customer and merchant.

One of the outstanding problems in the sale of washing machines on installment credit is in the use of many different methods for expressing the charge for this type of credit. Part of this variation is probably caused by the fact that a number of different agencies finance the contracts. In the study upon which this bulletin is based, the stores, as well as the financing agencies, were of many different types and were not united in any way that would promote standardization among themselves. Joint consideration of this problem might be one step toward improving the situation.

Installment purchasers should consider not only the amount of the charge, but the various methods of stating the charge, and which method from their point of view is most satisfactory. Thought on their part and the expression of such thought probably would have some influence at present, when methods of stating charges are under discussion.

In considering methods of expressing the charge, it should be kept in mind that customers do not make a standardized initial payment, nor do they wish to pay their contracts in the same length of time. This means that individual arrangements have to be made by the merchant, and that the charge must vary with the different circumstances. The present payment schedules used by the finance companies allow for this, but they do not state the amount of the finance charge, which must therefore be calculated by the purchaser. Furthermore, these schedules are not as clearly and conspicuously presented to the customer as they might be. Too frequently they are consulted only by the salesman, not by the customer.

The method of expressing the charge as a percentage per year of the decreasing unpaid balance was not used by any of the merchants visited in the study here reported. Such an expression of the charge would be helpful, at least to those who understood it. There are two points, however, that should be kept in mind in regard to such a method of quoting the charge. In the first place, one of the chief reasons why this method has not been welcomed by merchants is that the general public believes that 6 or 8 per cent is the correct and proper charge for credit. Despite the fact that a higher charge than this has been made legitimately by the small-loan companies for some time, the public still recognizes no difference in costs of granting credit. Responsibility for instructing the public about such differences must be assumed by those advocating a percentage quotation of this kind. In the second place, the charge should be expressed also in dollars and cents, a method as yet by no means universally used. Without the dollar-and-cent charge, the rate of percentage per year of the decreasing unpaid balance, or cost-rate as it is frequently called, is sometimes misleading. For example, from the data in the study reported in this bulletin, the installment buyer might have considered the high-priced washing machine the "best buy" if only the cost-rate were given, for the cost-rate was lower than for the low-priced machines; the amount of the finance charge was higher, however. If stores should make a more serious effort to arrange their charges according to the cost of handling accounts of different amounts, it would be more important than it is now for the purchaser to know both the cost-rate and the amount of the charge, since then the difference in the cost-rate for small and large purchases might be much greater than it is now.

Repossessions, like all types of failure to meet incurred obligations, result in losses. This means losses not only to the individual who fails to make the payment, and thus loses his purchase, but also to the person who fails to receive the payment, and who will attempt to pass on the loss in the form of an additional cost to the store's other customers. The prevention of such losses is, therefore, a problem facing household buyers in general, as well as those buyers whose articles are repossessed and the merchants concerned.

It is common knowledge that information is sought by merchants about customers' credit ratings. Investigations of this nature are expensive. Clear presentation of his financial status by the prospective credit purchaser is one way in which help can be given by those customers wishing to cooperate with stores in reducing costs. The advisability of such protective devices as the filing of contracts, a practice designed to keep merchants informed of customer commitments, is another measure that might well be considered.

Preventable credit losses should be recognized not merely as a store problem, but as a problem for all persons; and in the case of articles such as washing machines, for which the credit sales are large, as an especially important problem.

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APPENDIX

REASONS GIVEN FOR 73 REPOSSESSIONS OF WASHING MACHINES BY 70 STORES

Customer unwilling to complete payments (12):

Did not like machine.
Have not had sufficient service on machine but store said that since it had given customer an allowance for damage to machine, the customer thought that complaint was an easy way to avoid payments.
Customer was buying a car. "Slippery" or "crooked".
Customer was bad from beginning. Moved out of town leaving no address, but since did not pay mover he reported the new address.
Man was "crooked". Left town. Kept one or two good references but owed all others.
Stopped paying and moved machine. Damaged machine purposely in order to try to prevent store from collecting.
Just did not pay.
Would not pay.
Lost interest and let go back. Was working steadily.
Customer says he is out of work but is known to have had work. Curious case because store can sell the machine for more than is owed and has told purchaser of this buyer but he sent the washing machine back.
Refused to pay. Is unemployed but also had lost interest.
Family unstable. When son joined army, stopped paying.

Ability to complete payments misjudged (18):

Too little money and 3 or 4 children.
No money.
Widow with children, suing, and expected to get money from suit to pay for machine. Has not done so.
Bought a lot of furniture. Paying $3 a week.
Bought truck and found could not pay for both so brought back washer. Lost job in gas station. Was not a first-class risk to begin with.
Payments irregular. Making payments on truck. Bought beyond his means.
Bought refrigerator on same contract and did not want it when cold weather started, so brought back washer too.
Poor management. Had queer tendencies.
Poor management. Over-buying. Radio and washer purchased.
Poor management. Were earning but get into too much debt.
Other merchandise purchased. Were working but not steadily. Were poor credit risk.
Family left town. Left radio also. Had so many debts that thought they never could pay them. Debts were one of the reasons for moving.

Husband earns usually $17 a week, sometimes not more than $13. Has wife and twins. Said in store "Don't know why we ever sold to him."
Unemployed. Was poor credit risk and salesman never should have made sale.
Should have checked. Was poor credit risk.
Son-in-law started payments. Mother-in-law continued them but could not keep them up.
Farmer was going to pay from odd jobs which never materialized. Was not good credit risk but store was overstocked with that type of washer.
Machine left 3 months. Purchaser did not think store gave enough time to pay.

Conditions, out of control of customer, arose which caused customer to stop payments (41):

Breaking up home.
Husband died. Wife went to live elsewhere.
Family broke up. Wife died.
Family trouble. Husband left wife and she could not keep up payments.
Home broken up. Man who was responsible for payments no longer needs machine.
Wife left husband. He no longer needs machine.
Man and woman past middle age purchased the machine. Woman died. Man gave machine to daughter but she did want to finish payments.
Mother for whom machine was purchased died. Daughter decided not to continue payments.
Brother wanted machine for a debt. Purchaser voluntarily returned the machine. Very unusual because repossession is not practiced.
Family had bad luck in working.
Tuberculosis. No margin for emergencies.
Wife sick. Emergency bills. Could have continued payments but took this opportunity to get out of payments.
No reserve for emergencies.
Unemployment.
Out of work. Store gave them a second-hand machine.
Lost job. Left town. Just left machine when they moved. Doubtful to begin with.
Man injured and out of work. Could not get any compensation.
Unemployed. Man and child injured.
Out of work. Five children. Credit rating very good. Girl in store said this would not injure his credit because he could not help it. Had kept the machine in excellent condition.
Out of work; then moved. Can still get the machine if they pay in six weeks.
Lost job. Psychopathic-hospital case.
Bankruptcy.
Bought electric washer and then moved where there was no electricity (tenant farmer).

No reason given (2).

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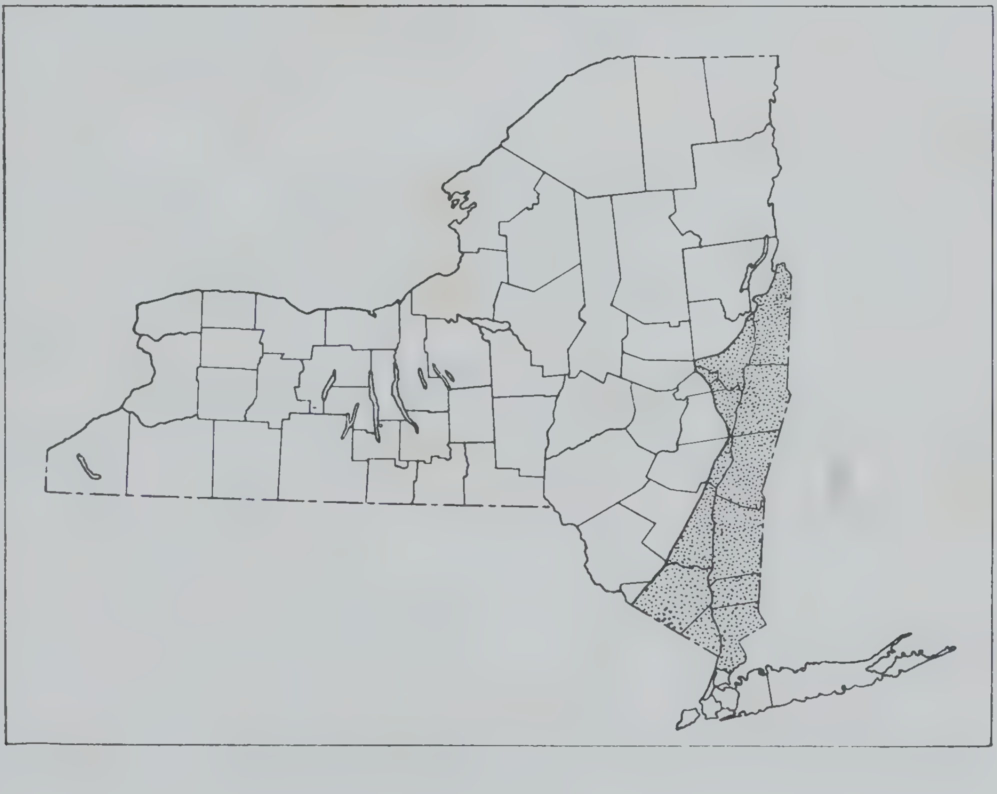
Bulletin 746

December 1940

Soil and Field Crop Management for Southeastern New York

A. F. Gustafson



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SOIL AND FIELD-CROP MANAGEMENT FOR SOUTHEASTERN NEW YORK

A. F. Gustafson

The southeastern New York area referred to in this publication is made up of Westchester, Putnam, Dutchess, Columbia, and Rensselaer Counties, and the southeastern part of Washington County on the east side of the Hudson River; and on the west side of the river, Rockland, nearly all of Orange, the southeastern part of Ulster, and the Hudson River bottomland parts of Greene, Albany, and Saratoga Counties. This is shown on the map on the cover.

CLIMATE

The climate of southeastern New York varies rather widely. Temperatures are affected by the elevations, which vary from sea level to as much as 2700 feet. Summers are of moderate length and relatively cool, and winters are relatively long and cold, particularly on the higher elevations at the north.

The length of the frost-free period is 186 days at Middletown, 175 days at Troy, 174 at Albany, and 146 at Chatham. The relatively long frost-free period near the Hudson River is favorable for the fruit industry that is located near it (table 1).

TABLE 1. Average Killing-frost Dates At Weather Bureau Stations in Southeastern New York*

Station	Elevation	No. of years	Latest frost in spring			Earliest frost in fall			Average frost-free period (days)
			Earliest	Average	Latest	Earliest	Average	Latest	
Albany	97	57	Apr. 7	Apr. 24	May 30	Sept. 15	Oct. 15	Nov. 6	174
Bedford Hills	425	34	Apr. 2	May 1	May 30	Sept. 20	Oct. 13	Oct. 29	166
Carmel	500	35	Apr. 8	Apr. 28	May 12	Sept. 14	Oct. 14	Oct. 30	169
Chatham	470	16	Apr. 16	May 11	May 27	Sept. 11	Oct. 4	Oct. 26	146
Greenwich	425	16	Apr. 23	May 13	May 29	Sept. 15	Oct. 7	Oct. 22	147
Hudson	165	25	Apr. 11	Apr. 29	May 12	Sept. 15	Oct. 9	Oct. 27	163
Middletown	700	18	Apr. 1	Apr. 17	May 12	Sept. 22	Oct. 19	Nov. 5	186
Rhinebeck	215	10	Apr. 12	May 3	May 26	Sept. 11	Oct. 5	Oct. 19	155
Troy	35	15	Apr. 5	Apr. 24	May 11	Sept. 11	Oct. 16	Nov. 7	175

*The climate of New York. By R. A. Mordoff. Cornell Univ. Agr. Exp. Sta. Bul. 444. 1934.

In general, the growing-season rainfall is ample for the production of good yields of the crops usually grown throughout the area. Detailed climatic data are given in *The Climate of New York*, by R. A. Mordoff (Bulletin 444 of this Experiment Station, 1934). (Table 2.)

GENERAL TOPOGRAPHY AND DRAINAGE

Southeastern New York consists of two principal topographic areas, the Hudson lowland and the foothill-and-mountain area (figure 1). The Hudson area consists of two divisions: (1) the first bottom of the Hudson River, the total area of which is very small; (2) the nearly level plain,

TABLE 2. PRECIPITATION FOR POINTS IN SOUTHEASTERN NEW YORK*

Station	Period	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Growing season†
	Years	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Albany	105	2.51	2.43	2.73	2.73	3.33	3.85	3.88	3.72	3.28	3.22	2.93	2.57	37.18	18.06
Bedford Hills	40	3.55	3.47	3.46	3.48	3.98	3.67	4.63	4.66	3.81	3.68	3.40	3.56	45.35	20.75
Carmel	41	3.70	3.74	4.11	3.74	3.89	3.76	4.94	5.00	4.17	3.85	3.68	3.74	48.32	21.76
Catskill	6	2.60	3.41	3.26	2.41	4.26	2.83	4.42	3.33	3.93	2.28	3.26	3.30	39.29	18.77
Chatham	20	2.24	2.51	3.06	3.70	3.04	3.99	3.77	3.93	3.49	3.36	2.28	2.74	38.11	18.22
Greenwich	15	2.57	2.22	3.50	2.31	3.47	2.92	3.14	3.44	3.88	2.96	2.50	2.86	35.77	16.85
Hoosick Falls	18	2.34	2.32	2.91	2.72	3.04	3.73	4.37	3.73	3.36	3.10	2.57	2.30	36.49	18.23
Hudson	29	2.70	2.66	2.66	3.09	3.17	3.90	3.87	3.65	3.14	3.89	2.95	3.18	38.86	17.73
Kinderhook	17	2.21	1.53	2.48	2.97	3.41	4.49	4.36	3.23	2.84	3.26	2.69	2.76	36.23	18.33
Kingston	24	3.70	2.65	3.13	2.51	4.00	3.83	4.21	3.39	2.50	3.31	3.47	3.31	40.01	17.93
Middletown	18	3.13	4.02	4.12	3.17	4.03	4.06	5.40	4.61	4.19	3.74	3.24	3.48	46.83	22.29
Poughkeepsie	27	3.13	2.86	3.14	2.47	3.48	3.07	3.89	4.08	2.85	3.24	3.21	2.89	38.31	17.37
Red Hook	15	2.78	1.94	3.26	3.32	2.94	4.30	4.25	3.81	3.05	3.21	2.45	3.10	38.41	18.35
Troy	79	2.34	2.19	2.42	2.80	3.14	3.72	3.78	3.35	3.20	3.29	2.90	2.44	35.57	17.19
West Point	75	3.44	3.33	3.62	3.68	4.03	3.45	4.33	4.36	3.66	3.64	3.77	3.45	44.76	19.83
White Plains	26	5.50	4.68	4.18	4.01	3.41	3.50	4.99	4.58	3.57	3.87	4.28	4.88	51.45	20.05

*The climate of New York. By R. A. Mordoff. Cornell Univ. Agr. Exp. Sta. Bul. 444:75–80. 1934.

†May 1 to September 30.

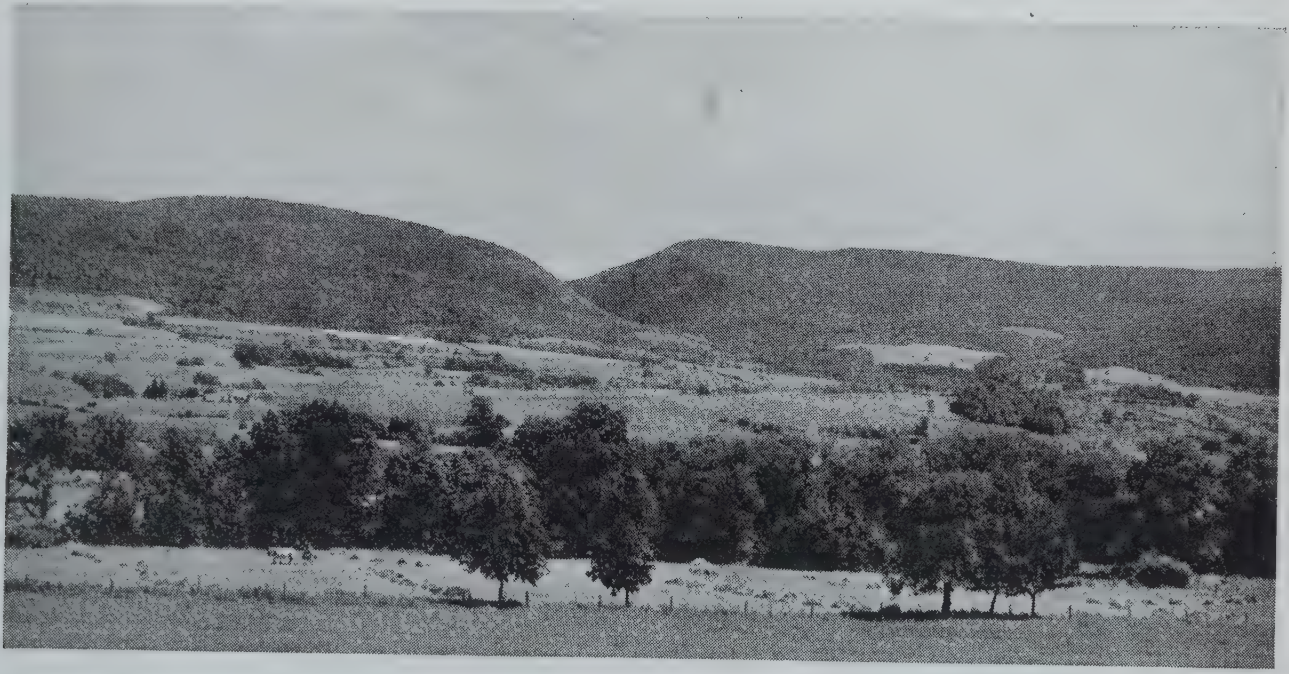

FIGURE 1. TACONIC MOUNTAINS

The pasture and meadow in the foreground are on Bernardstown gravelly loam; the gently undulating land near the middle is Pittsfield soil. The notch in the skyline was cut by the creek which forms Copake Falls

or the old Hudson River terrace. In general, its topography is flat, with some V-shaped valleys cut into it by small streams and by the larger ones that carry drainage across the Hudson area from the foothill lands. Even more important agriculturally, is the outwash gravel deposited by the larger streams, particularly in the counties on the east side of the Hudson River. In the southern part of the area, the Hudson lowland

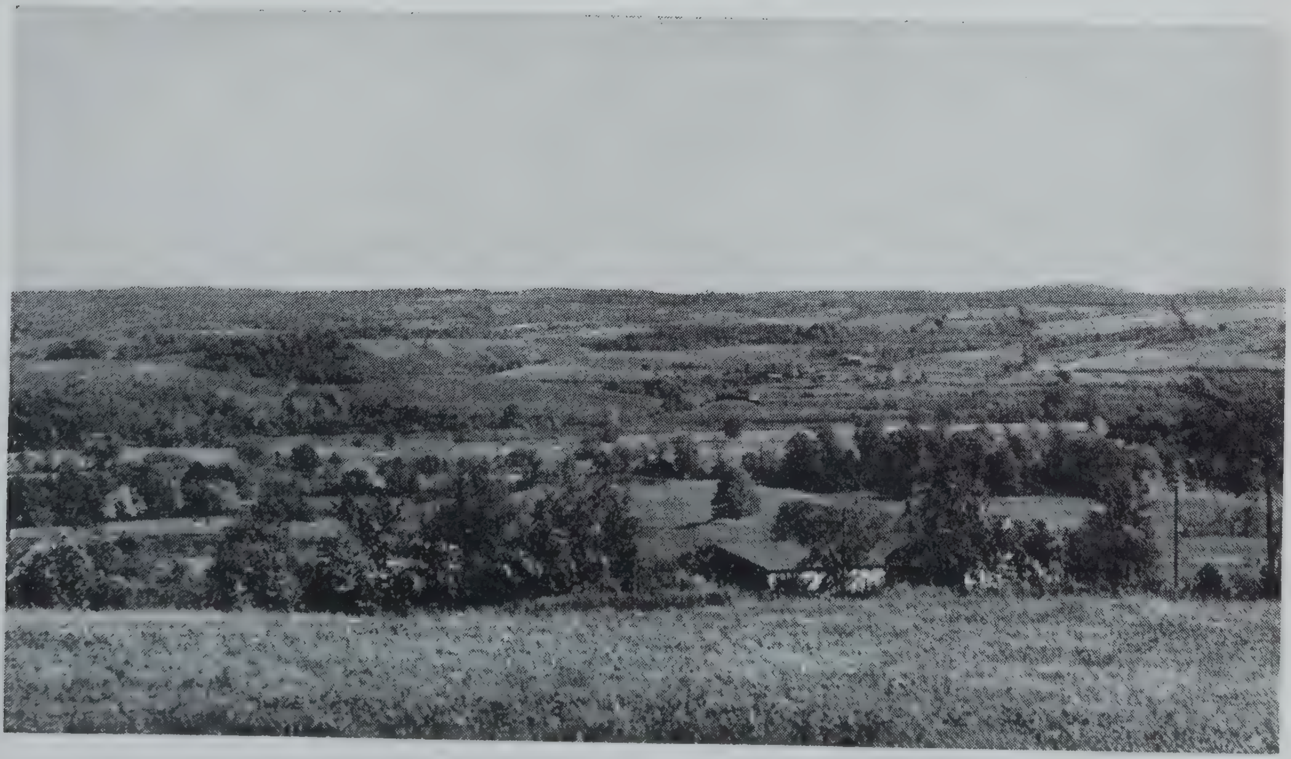

FIGURE 2. DUTCHESS SOILS

Dutchess soils in the background with Cossayuna in the immediate foreground

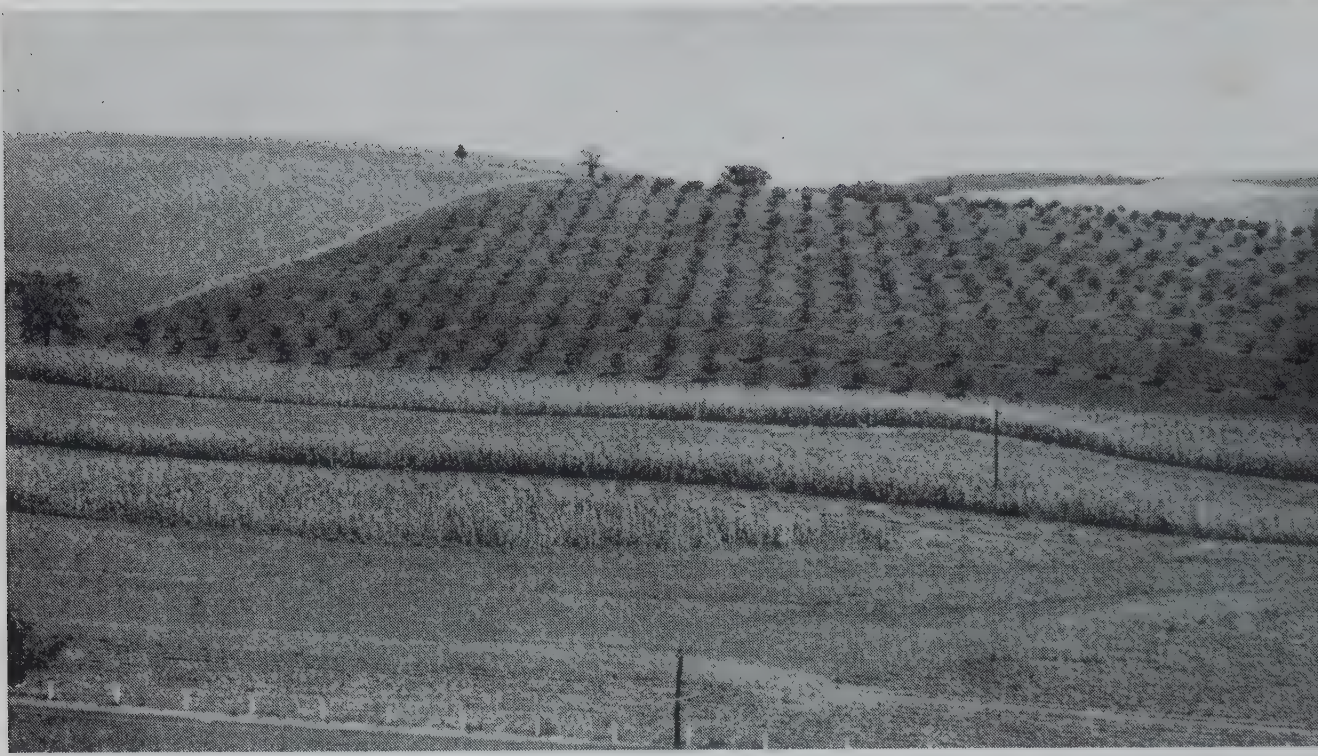

FIGURE 3. CO

This fine young orchard is located on a rather steeply sloping hill of Cossayu
trees controls soil erosion and benefits the trees, and at the

disappears completely and the foothill area borders the river (figure 2).

The flatter part of the Hudson lowland is lacking in surface drainage. In many places, however, the smaller streams have cut into the clay deposit, and afford a good opportunity for surface water to run off. The surface drainage of the hill section is, in general, good to excessive (figure 3).

The "hill section" is variable in topography, from the flat Hudson area to the mountains of more than 2000 feet in elevation. An extreme elevation of 2700 feet is reached at some points in the mountains. The area may be characterized as *rolling,* in the lower foothills, through *rugged to mountainous* in the higher areas. The agriculture of the upland proper is confined mainly to the rolling part of this section (figure 4).

TRANSPORTATION FACILITIES

Southeastern New York is well supplied with transportation facilities. Most important in the early days was the boat traffic on the Hudson River. More recently, the railroads have held first place in the movement of farm products to market and of supplies to the farm. At present, of equal, if not of greater, importance than rail traffic is that carried by trucks on the hard-surface roads. Of these, southeastern New York has a perfect network, including important trunk highways north and south on both sides of the Hudson River, and the important main roads east and west. Much farm produce is taken direct to market by truck over these roads. The Hudson River, however, is still functioning as an important means of transportation of bulky products.

ELLY LOAM
with rows of trees planted near the contour. The alfalfa between the young
ces a fair yield of excellent hay. Dutchess soils in far background

MARKETS

Southeastern New York farms have at their very front door one of the best markets for farm products in America. The New York City area, with its population of 9,000,000; the Albany district, with 350,000; and Boston and other cities are a potential market for far more of agricultural products than this area can possibly produce.

General information that may prove helpful in connection with this bulletin is found in a number of publications of the Cornell Extension Service, of this Agricultural Experiment Station, and of the United States Department of Agriculture.

Soil maps have been made of the entire area except Greene County. Reports of Orange, Saratoga, Washington, and Dutchess Counties, and the White Plains Area (Westchester, Putnam, and Rockland Counties) are out of print but may usually be consulted at the local county agricultural agent's office and in libraries. Reports and soil maps of Columbia and Rensselaer Counties are available from Congressmen and county agents and from the Cornell University Agricultural Experiment Station. Ulster, Albany, and Schenectady Counties have been mapped, and Dutchess County was remapped recently. Reports and soil maps of these counties will become available later. The land-classification report for Rensselaer County is available (Experiment Station bulletin 675, by R. S. Beck, 1937). The following publications of the New York State College of Agriculture and of the Cornell University Agricultural Experiment Station contain valuable additional information:

Soils in relation to fruit growing in New York. Part VII. Tree behavior on important soil profiles in the Kinderhook, Germantown, and Red Hook areas in Columbia and Dutchess Counties. By L. P. Batjer and Joseph Oskamp. Exp. Sta. bul. 627. 1935.

Soils in relation to fruit growing in New York. Part XI. The organic-matter content of New York orchard soils in relation to orchard performance. By Ralph W. Cummings. Exp. Sta. bul. 672. 1937.

Liming New York soils. By A. F. Gustafson. Cornell ext. bul. 78. Reprinted 1940.

Meadow improvement through seeding, fertilization, and management. By A. F. Gustafson. Cornell ext. bul. 181. Reprinted 1937.

Drainage, plowing, and seedbed preparation. By A. F. Gustafson. Cornell ext. bul. 183. Reprinted 1938.

Pasture improvement and management. By D. B. Johnstone-Wallace. Cornell ext. bul. 393. 1938.

The control of soil erosion in New York. By A. F. Gustafson. Cornell ext. bul. 438. 1940.

Publications dealing with problems of fruit and vegetable production are available from the county agent and from the New York State College of Agriculture.

AGRICULTURE

The agriculture of southeastern New York, as shown in table 2, is predominately dairying, fruit-growing, poultry-raising, and vegetable production. Most of the forage for dairy cows, except near New York City, is produced in the area. A large share of the grain fed to cows and poultry, however, is shipped in from the Midwest.

The potato acreage has dropped materially during recent years but the combined acreage of sweet corn, tomatoes, and other vegetables is greater than the loss in acreage of potatoes.

Columbia County is fairly representative of the mid-Hudson fruit section (figures 5 and 6). In this county the number of apple and cherry trees more than doubled from 1900 to 1935; the number of peach trees is five times as great; pear trees more than three times; and grapevines

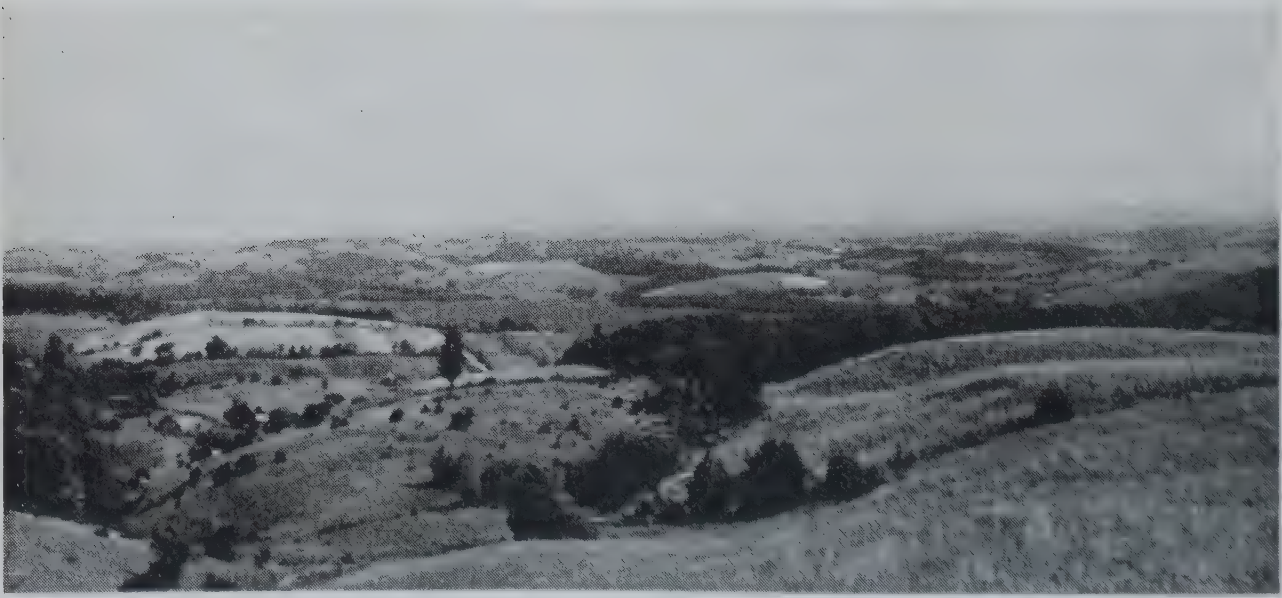

Figure 4. cossayuna and nassau soils west of ramertown, rensselaer county

three times; but the number of plum trees decreased from 1900 to 1935. From the number of fruit trees not of bearing age in 1935, it appears that some of the trees that were winterkilled in February, 1934, have already been replaced by young trees (table 3).

TABLE 3. ACREAGE OF CROPS AND NUMBERS OF LIVESTOCK IN COUNTIES OF SOUTHEASTERN NEW YORK*

Items	Columbia	Dutchess	Orange	Rensselaer	Ulster	Washington
1. Hay, all kinds (acres)	64,560	77,858	99,864	74,276	54,672	110,723
2. Timothy, timothy and clover, and clover (acres)	48,989	46,426	49,874	56,251	39,260	99,164
3. Alfalfa (acres)	3,446	4,744	4,344	1,650	1,013	2,651
4. Pasture plowable and other (acres)	75,861	105,302	108,109	66,719	60,259	144,751
woodland (acres)	14,567	14,347	16,825	23,709	20,460	41,173
5. Small grains for hay (acres)	317	1,121	4,072	243	752	650
6. Annual legumes (acres)	46	178	44	10	77	110
7. Corn, field, all purposes (acres)	13,944	17,208	14,437	13,104	10,466	23,232
8. Wheat (acres)	450	1,068	694	227	1,540	194
9. Oats and mixed grain (acres)	8,665	9,923	3,351	2,444	4,830	17,464
10. Barley (acres)	62	29	......	38	65	355
11. Rye (acres)	2,452	585	218	1,535	380	915
12. Potatoes (acres)	1,394	1,491	1,867	4,439	1,334	5,529
13. Vegetables (acres)	717	1,033	7,056	2,694	3,488	363
14. Sweet corn (acres)	2,980	849	1,221	1,504	1,445	155
15. Tomatoes (acres)	229	208	304	182	1,078	22
16. Strawberries (acres)	258	155	104	165	310	64
17. Apples (trees)	655,622	431,273	257,583	112,245	555,503	71,487
18. Cherries (trees)	132,834	11,777	30,793	4,322	52,188	3,545
19. Peaches (trees)	63,099	46,432	144,690	10,127	128,561	434
20. Pears (trees)	232,735	39,911	41,866	19,292	129,018	1,396
21. Plums (trees)	10,686	4,526	3,699	2,527	11,929	2,872
22. Grapes (vines)	1,110,318	459,472	450,233	35,956	2,719,810	3,974
23. Horses and mules (number)	4,215	4,558	5,715	4,599	4,364	6,271
24. Cattle, total (number)	23,090	35,590	50,912	26,059	23,454	45,529
25. Cows (number)	15,079	21,159	39,044	18,164	15,733	33,054
26. Swine (number)	2,105	3,721	2,502	2,281	2,133	2,516
27. Sheep and goats (number)	7,327	3,594	1,052	7,775	1,935	12,484
28. Chickens (number)	160,970	217,071	383,183	209,064	452,307	174,773

*U. S. Census of Agr.: 1935, New York. Crop acreages for 1934; numbers of livestock, April 1, 1935.

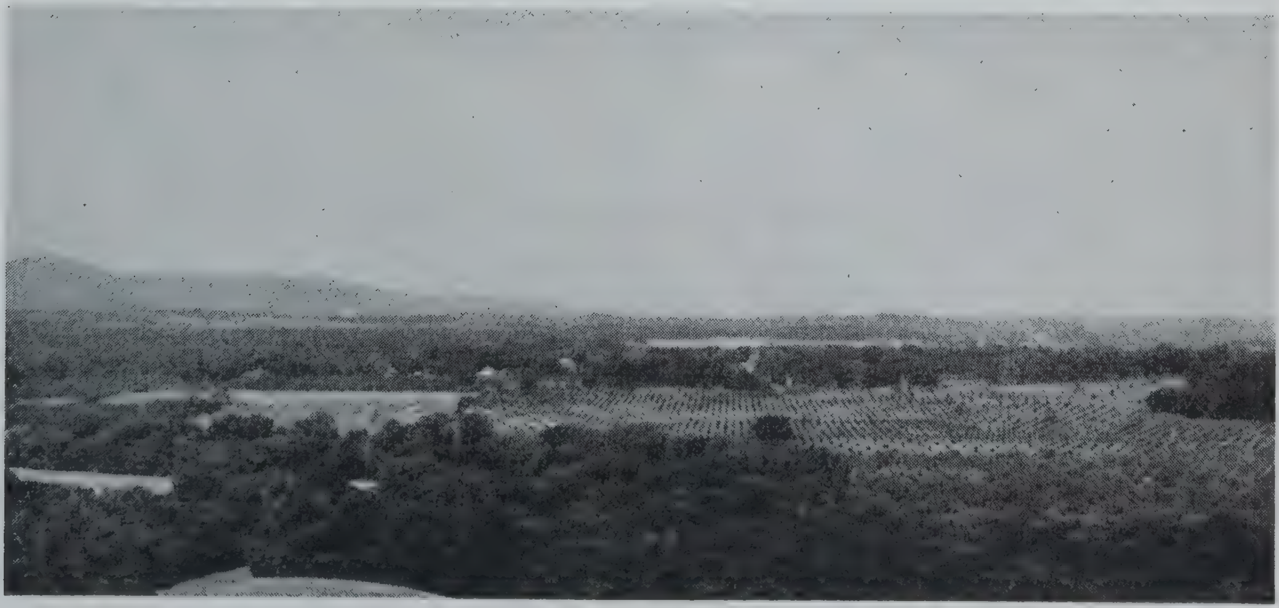

FIGURE 5. HOOSIC AND HUDSON SOILS

The apple orchard at the right is largely on Hoosic gravelly fine sandy loam. The flat area running the length of the view is the general Hudson lowland with its Hudson soils

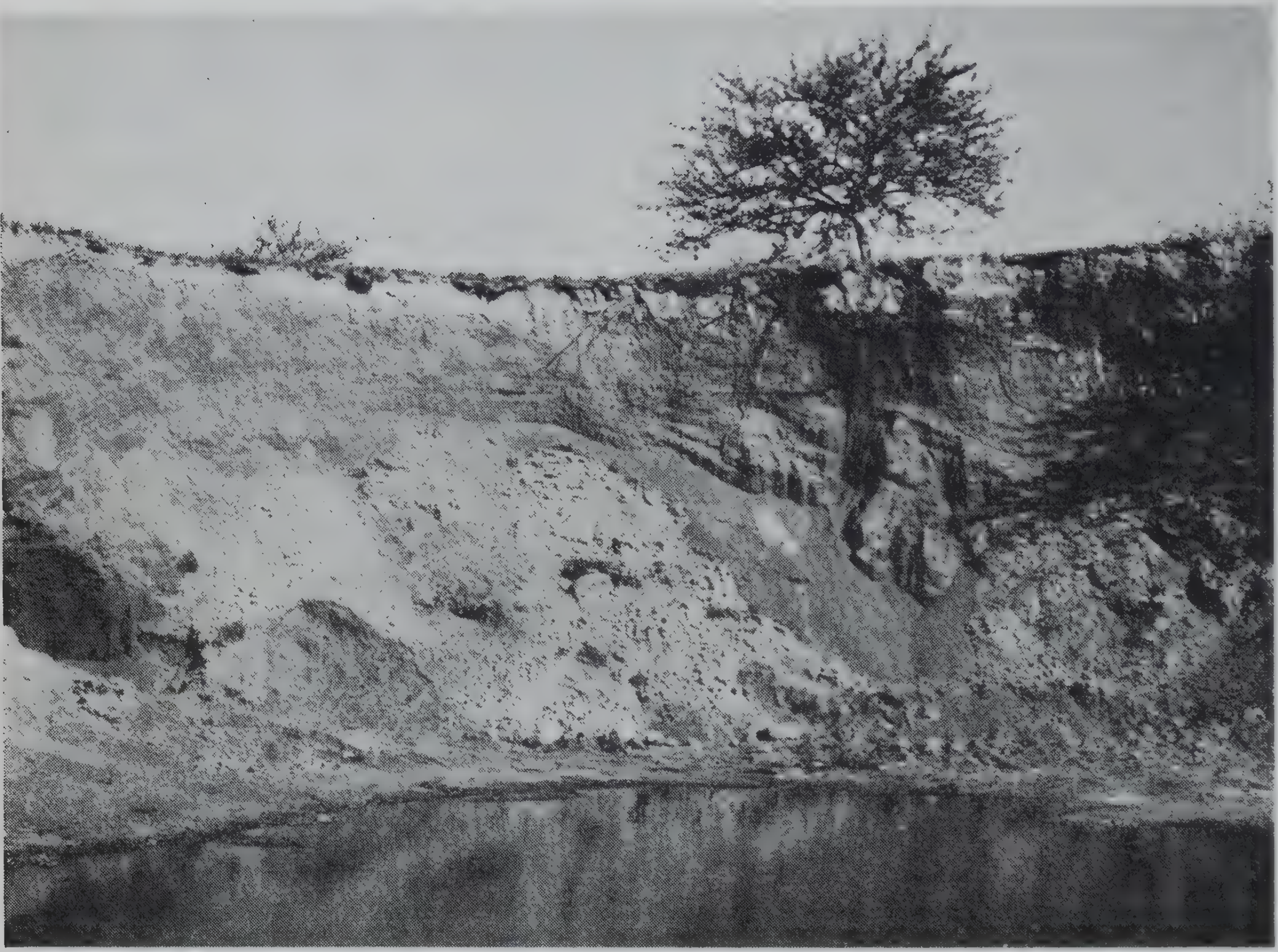

FIGURE 6. GRAVEL UNDER HOOSIC GRAVELLY LOAM

The separation into layers of different-sized gravel is clearly evident. The Hoosic soils owe their perfect underdrainage to this gravel substratum

A slight drop has occurred in the number of milk cows. The outstanding change in number of livestock has been the drop in the number of horses, swine, and sheep.

Orange County is representative of the agriculture on the west side of the Hudson River. A slight falling off has taken place in the acreage of hay. A notable increase has occurred, however, in the acreage of both clover and alfalfa. The acreage of potatoes has fallen off very markedly, but that of vegetables has increased; in fact, it doubled from 1924 to 1934. As representative of individual vegetables, both tomatoes and sweet corn have doubled during the 1924–34 period.

Fruit production in Orange County, as indicated by the number of trees, has changed greatly in recent years. The number of apple and cherry trees and of grapevines more than doubled during the 25 years from 1910 to 1935. During this period, the number of peach, pear, and plum trees, however, dropped below half of the number reported in 1910. The most severe drop is in the number of plum trees.

The livestock situation in Orange County is similar to that in Columbia, and is representative of that in the area, except that urbanization has proceeded more rapidly and much further in the more southerly part of this area.

The number of milking cows was nearly one-sixth less in 1935 than in 1910. The total production of milk, however, is being maintained.

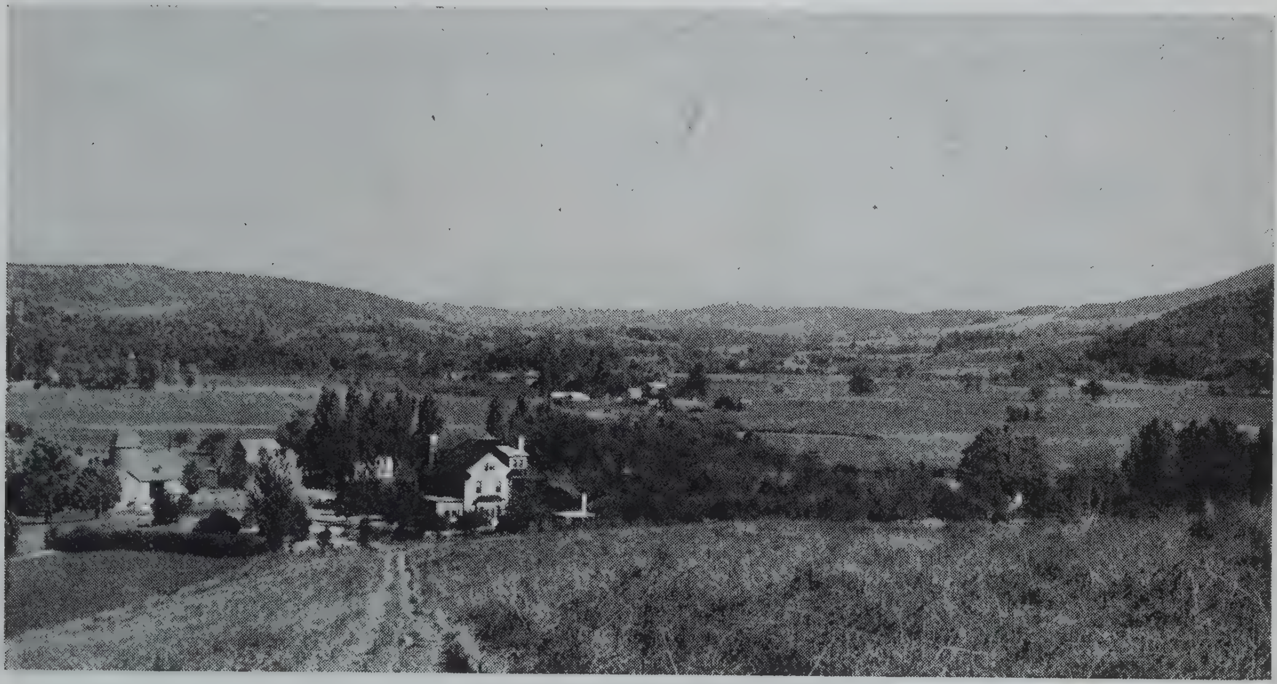

Figure 7. COPAKE GRAVELLY LOAM, IN THE VALLEY

Corn stubble on Pittsfield stony loam in immediate foreground; alfalfa at left. Shelf in left background also Pittsfield stony loam. Rough stony land at extreme left and right in background

The number of horses, sheep, and swine has dropped rapidly, but the number of chickens has undergone a considerable increase during this period. As in Columbia County these shifts in the agriculture of Orange County are all favorable and dictated by price relationships of the products of these farms, and by the cost of the necessary supplies.

The changes are from the production of livestock feed to food for man. The best use of the more productive, more easily accessible agricultural soils is for the growing of crops for human consumption on an increasing proportion of the suitable acreage.

The less productive, less accessible, less easily tilled lands will be used for producing hay and pasture for dairy cows. The land still lower in the productivity scale and less accessible will be reforested with or without man's assistance.

An increase in the use of land for non-farm or rural residences is likely to take place on all soils and on all kinds of land in southeastern New York. The least accessible, if used, may well be taken up for summer homes and camps. Should any large share of the population have increasing leisure, a considerable acreage of land may be used to good advantage for recreation.

THE SOILS OF SOUTHEASTERN NEW YORK

Composition. All of the chemical elements needed for plant growth are probably present in all soils (figures 7, 8, and 9). Usually, however, one or two elements are present in such small quantities or in such unavailable form that crops are unable to obtain enough of them for satisfactory growth. The elements most commonly deficient are nitrogen and phosphorus, and sometimes potassium, sulfur, calcium, and magnesium.

FIGURE 8. ALFALFA ON PITTSFIELD STONY LOAM
This third growth of alfalfa is equivalent to more than a ton of hay to the acre

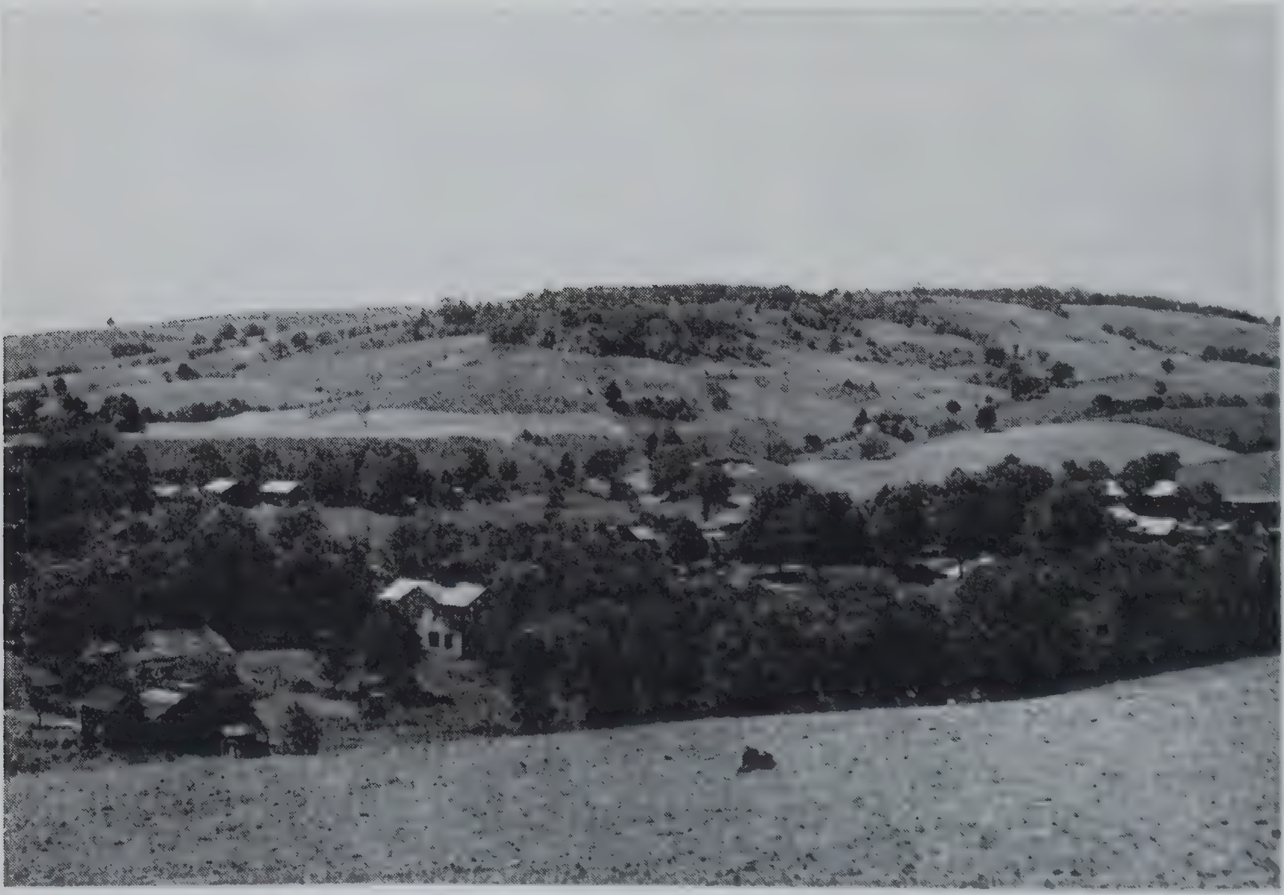

FIGURE 9. VIEW OVER GALLATINVILLE
Gravel pit in center, and to the left and right of it, Otisville gravelly loam. Dutchess in foreground and extreme background, with Bernardstown on lower slope beyond gravel pit

The surface 8 inches of loams, silt loams, and clay loams over an acre weighs about 2,500,000 pounds. The composition of soils collected in Columbia, Orange, and Dutchess Counties is given in table 4.

TABLE 4. COMPOSITION OF SOILS IN SOUTHEASTERN NEW YORK*

Soils and county where sample was taken	Depth of soil in inches	Plant-nutrient elements in the soil (pounds in 2,500,000 dry basis)					
		Nitrogen	Phosphorus	Potassium	Sulfur	Calcium	Magnesium
Cossayuna gravelly loam† Columbia (71)‡	0–8	5,100	1,925	45,500	925	5,750	17,000
	8–24	1,975	1,175	49,000	800	3,250	18,500
	24–36	2,275	1,225	73,500	1,750	1,750	26,750
Hudson silty clay loam§ Columbia (72)‡	0–8	5,125	1,675	60,000	1,525	3,250	21,500
	8–24	2,900	1,125	84,250	925	3,500	32,500
	24–36	2,350	1,425	87,750	825	30,750	39,000
Hudson silty clay loam§ Columbia (93)‡	0–8	6,050	1,125	61,000	1,250	9,000	23,500
	8–24	2,650	825	82,000	475	3,500	30,250
	24–36	2,425	1,100	82,500	475	5,500	34,750
Merrimac gravelly sandy loam Dutchess (83)‡	0–8	3,800	2,400	32,250	1,225	3,250	17,000
	8–24	1,600	1,750	48,750	450	3,000	25,250
	24–36	800	1,125	51,750	500	3,000	27,500
Pittsfield gravelly loam‖ Dutchess (29)‡	0–8	5,375	2,125	71,500	3,275	10,500	20,250
	8–24	1,475	1,200	73,250	2,450	7,250	24,500
	24–36	1,450	1,725	72,250	2,525	9,000	24,750
Gloucester stony loam Dutchess (28)‡	0–8	4,875	1,950	43,250	3,075	21,500	32,500
	8–24	3,800	2,350	55,250	3,175	18,750	29,750
	24–36	700	1,000	64,000	2,450	17,500	49,250
Dutchess silt loam Orange (32)‡	0–8	5,375	1,375	26,750	2,600	4,500	11,000
	8–24	1,925	700	33,250	2,175	4,500	13,500
	24–36	1,375	825	38,750	1,425	6,500	14,500
Dutchess silt loam Dutchess (70)‡	0–8	4,200	1,475	39,000	675	6,000	16,500
	8–24	1,825	1,175	50,750	375	4,250	20,750
	24–36	1,575	1,125	59,500	450	9,000	24,250

*From *The Chemical Composition of New York Soils*, by J. A. Bizzell (Cornell Univ. Agr. Exp. Sta., Bul. 513, 1930).

†Formerly called Dutchess silt loam.

‡Designation number from bul. 513 of this Station.

§Formerly called Dunkirk.

‖Mapped as Dover loam in Dutchess County.

Because these are all virgin timber soils, the quantities of nitrogen and phosphorus in them are higher than may be expected in most field soils that have been cropped for a century or more, unless goodly applications of fertilizer and manure have been made.

With but one or two exceptions, the supply of phosphorus is low; and, without exception, applications of materials carrying this element may be expected to increase yields. Potassium appears to be present in abundance, but in some soils it may not be available to plants in sufficient quantities for good growth of some crops, particularly in the sandy and gravelly soils. Some samples, notably the second of the Dutchess silt loam, are unusually low in sulfur. This element may be supplied in manure and superphosphate or in sulfate of ammonia, or in mixed fertilizers containing these materials. All of the surface soils represented in table 4, except the Gloucester and Pittsfield soils, appear to be abnormally low in calcium, and in need of additions of it for best growth of crops, especially of legumes.

Soil series	Important or main type	Position	Topography	Soil
Adirondack	Stony sandy loam	Upland	Mountainous	Brown
Agawam	Loamy fine sand	Terraces	Flat to undulating	Brown
Albia	Gravelly loam	Upland	Rolling	Gray-brown
Allis	Shale loam	Upland	Rolling	Gray-brown
Alps	Gravelly silt loam	Upland	Rolling	Pinkish brown
Barbour	Silt loam	First bottom	Flat	Reddish brown
Basher	Silt loam	First bottom	Flat	Reddish brown
Bernardston	Gravelly loam	Upland	Rolling	Dark brown
Boynton	Gravelly silt loam	Upland	Flat to undulating	Dark brown
Charlton	Stony loam	Upland	Rolling	Brown-gray
Chenango	Gravelly loam	Terraces	Flat	Gray-brown
Claverack	Fine sandy loam	Terraces	Flat	Brown
Clyde	Loam	Upland	Flat	Black
Colonie	Fine sandy loam	Terraces	Flat	Light brown
Copake	Loam	Terraces	Flat	Brown
Cossayuna	Gravelly loam	Upland	Rolling	Dark grayish br
Danby	Gravelly sandy loam	Upland	Hummocky	Gray
Dover	Loam	Upland	Undulating to rolling	Brown
Dutchess	Silt loam	Upland	Rolling	Gray-brown
Eel	Silt loam	First bottom	Flat	Dark
Essex	Stony loam	Upland	Rolling	Gray-brown
Farmington	Gravelly loam	Upland	Usually flat	Dark brown
Fox	Gravelly loam	Terraces	Flat to undulating	Brown
Genesee	Silt loam	First bottom	Flat	Dark brown
Ghent	Silty clay loam	Terraces	Flat	Dark brown
Gloucester	Loam	Upland	Rolling	Brown
Graywacke	Stony loam	Upland	Rolling	Dark gray
Groton	Gravelly loam	Upland	Hummocky	Gray
Hartford	Sandy loam	Terraces	Flat	Reddish brown
Hermon	Stony loam	Upland	Rolling	Gray
Hinckley	Sandy loam	Upland	Hummocky	Brown
Holly	Silt loam	First bottom	Flat	Gray
Holyoke	Stony loam	Upland	Rolling	Brown
Hoosic	Gravelly loam	Terraces	Flat	Brown
Hudson	Silty clay loam	Terraces	Flat	Gray-brown
Livingston	Silty clay loam	Terraces	Flat	Dark gray
Macomber	Slate loam	Upland	Rolling	Gray
Madalin	Silty clay loam	Terraces	Flat	Dark gray
Mansfield	Silty clay loam	Upland	Flat to depressions	Gray
Merrimac	Gravelly loam	Terraces	Flat to undulating	Brown
Middlebury	Silt loam	Terraces	Flat	Grayish brown
Nassau	Shale loam	Upland	Rolling	Gray
Ondawa	Silt loam	First bottom	Flat	Grayish brown
Orono	Silt loam	Terraces	Flat	Dark brown
Otisville	Gravelly sandy loam	Upland	Hummocky	Grayish brown
Peru	....	Upland	Flat to undulating	Black
Pittsfield	Stony loam	Upland	Undulating to rolling	Dark brown
Podunk	Silt loam	First bottom	Flat to undulating	Grayish brown
Poygan	Silty clay loam	Terraces	Flat	Dark brown
Rhinebeck	Loam	Terraces	Flat to undulating	Brown
Saco	Silt loam	First bottom	Flat	Dark
Scarboro	Loam	Terraces	Flat	Dark brown
Schodack	Gravelly fine sandy loam	Upland	Hummocky	Grayish brown
Schoharie	Silty clay loam	Upland	Undulating to flat	Light brown
Stockbridge	Loam	Upland	Rolling	Brown
Sutton	....	Upland	Flat	Brown
Tioga	Silt loam	First bottom	Flat	Brown
Troy	Gravelly loam	Upland	Rolling	Brown
Tunkhannock	Gravelly loam	Terraces	Flat	Reddish brown
Tyler	Silt loam	Terraces	Flat	Dark brown
Vergennes	Clay	Terraces	Flat	Dark gray
Walkill	Silt loam	First bottom	Flat	Dark brown
Wethersfield	Fine sandy loam	Upland	Rolling	Grayish brown
Whitman	Stony loam	Upland	Flat to depressions	Dark brown
Woodbridge	Stony loam	Upland	Rolling	Brown

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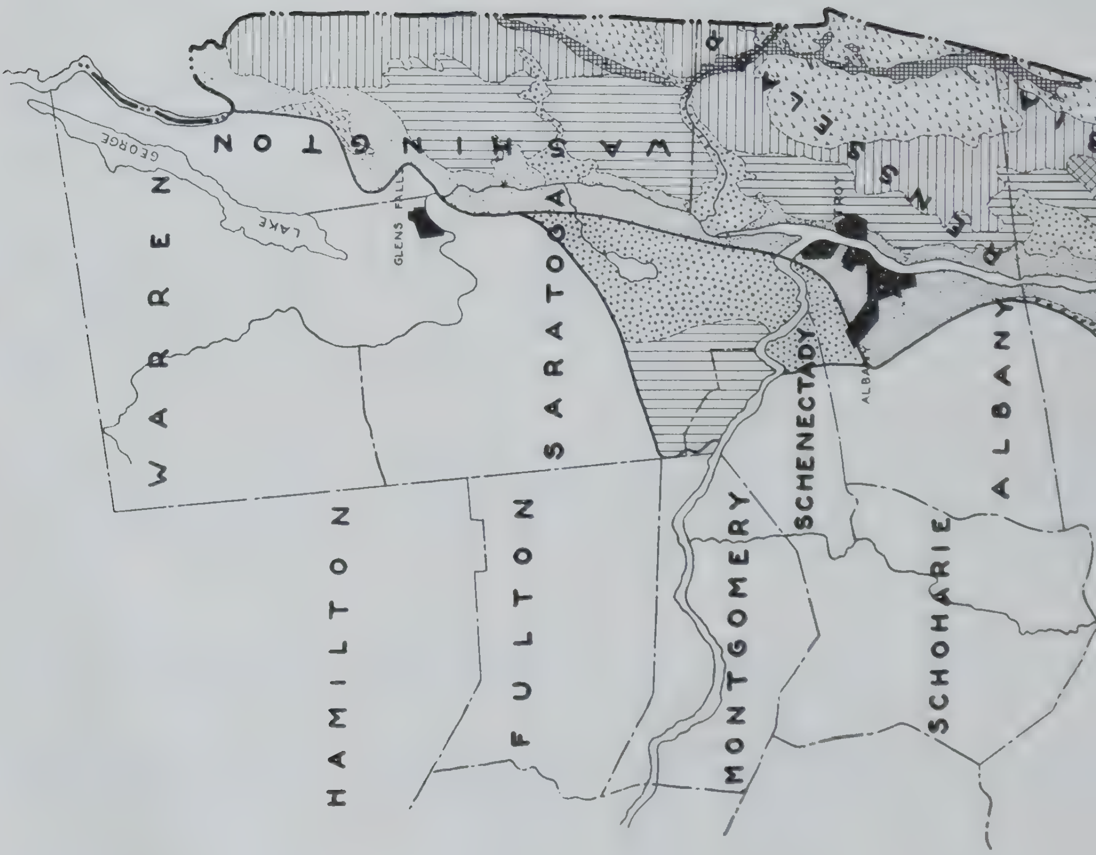
*Some soils not listed may be given in the forthcoming Dutchess County report.

†Adapted for fruits in the fruit zone.

F SOUTHEASTERN NEW YORK SOILS*

r	Drainage	Reaction	Crop adaptations
Subsoil			
ight brown	Good	Acid	Forest
ight brown	Well-drained	Acid	Hay, pasture, forest, corn, oats
ellowish	Imperfect	Calcareous (mildly)	Hay, pasture, corn, oats
luish gray	Poor—imperfect	Acid	Hay, pasture, forest
rownish	Imperfect	Calcareous (mildly)	Pasture, forest
rown	Good	Acid	Corn, oats, hay, pasture
ray	Poorly drained	Acid	Hay, pasture
ellowish	Well-drained	Acid	Grass, and alsike for hay, oats, pasture
luish gray	Imperfect	Calcareous (mildly)	Corn, oats, hay, pasture, some cabbage
ray	Well-drained	Acid	Pasture, hay, feed crops
ellowish brown	Well-drained	Acid	Corn, oats, hay, alfalfa†
rayish	Fair	Calcareous (mildly)	Fruits, vegetables, feed crops†
ark gray	Poorly drained	Calcareous	Hay, pasture, corn, oats
ellowish brown	Well-drained	Acid	Pasture, fruits, corn, potatoes, wheat†
ight brown	Well-drained	Calcareous (mildly)	Alfalfa, corn, potatoes, oats†
ellow	Well-drained	Calcareous (mildly)	Fruit, vegetables, feed crops†
ellowish brown	Excessively drained	Acid	Alfalfa, clover, corn, oats†
eddish brown	Good	Calcareous	Alfalfa, clover, corn, oats, hay†
ight brown	Well-drained	Acid	Corn, oats, clover, potatoes, hay†
rayish brown	Imperfect	Calcareous	Pasture, some hay
rayish brown	Well-drained	Acid	Pasture, hay, feed crops
ight brown	Good	Calcareous	Alfalfa, hay, oats, pasture
ight brown	Well-drained	Calcareous	Same as Hoosic†
rown	Good	Calcareous	Pasture, hay, feed crops
ottled gray	Poorly drained	Acid	Hay, pasture, corn, oats
ight brown	Well-drained	Acid	Hay, pasture, forest
ellowish	Well-drained	Calcareous	Pasture, forest
rown	Well-drained	Calcareous	Alfalfa, clover, feed crops, fruit†
rown	Good drainage	Acid	Alfalfa, clover, feed crops†
ight brown	Well-drained	Acid	Hay, pasture, corn, oats, potatoes, forest
ight brown	Well-drained	Acid	Alfalfa, clover, wheat, corn, oats, potatoes
ottled gray	Poorly drained	Acid	Pasture, some hay
ellowish brown	Well-drained	Acid	Corn, oats, hay, alfalfa
ight brown	Well-drained	Acid	Alfalfa, fruit, corn, potatoes, wheat†
ray	Imperfectly drained	Calcareous	Corn, oats, clover, pasture, some fruit†
ottled gray	Poorly drained	Calcareous	Pasture, hay, some corn, oats
ight brown	Well-drained	Acid	Corn, oats, hay, pasture
ottled gray	Imperfectly drained	Calcareous	Pasture, hay, corn, oats
ight gray	Poorly drained	Acid	Pasture, hay
ight brown	Well-drained	Acid	Alfalfa, clover, corn, oats
ottled gray	Imperfectly drained	Acid	Pasture, hay
ellowish	Well-drained	Acid	Corn, oats, alfalfa, hay, wheat
rayish	Fair to good	Acid	Pasture, hay
rown	Well-drained	Calcareous (mildly)	Corn, oats, hay, pasture
rown	Excessively drained	Acid	Alfalfa, clover, corn, oats, fruit†
ottled gray	Imperfectly drained	Acid	Hay, oats, corn, pasture
live drab	Well-drained	Calcareous (mildly)	Alfalfa, clover, corn, oats, hay, fruit†
rayish	Imperfectly drained	Acid	Pasture, hay, corn, oats
eddish	Poorly drained	Calcareous	Pasture, hay
ottled brown	Imperfectly drained	Calcareous	Corn, oats, hay, pasture
live gray	Poorly drained	Calcareous (mildly)	Pasture, hay, corn, oats
ottled gray	Poorly drained	Acid	Corn, oats, hay, pasture
ellowish	Excessive	Calcareous (mildly)	Alfalfa, clover, corn, oats, fruit†
inkish	Fair	Calcareous	Corn, oats, clover, hay
ellowish	Good	Calcareous	Corn, oats, hay, clover, alfalfa
ottled gray	Poorly drained	Acid	Hay, pasture, corn, oats
ight brown	Well-drained	Acid	Corn, oats, hay, pasture, clover
ellowish	Well-drained	Calcareous (mildly)	Corn, oats, hay, pasture, alfalfa†
rown	Well-drained	Acid	Alfalfa, corn, oats, clover, wheat
. . . .	Poor	Calcareous	Pasture, hay
rayish	Imperfectly drained	Calcareous	Hay, pasture, clover, corn
lack	Poorly drained	Acid	Pasture, hay
eddish	Well-drained	Acid	Corn, oats, clover, alfalfa†
ray-brown	Poorly drained	Acid	Pasture, forest
ellowish brown	Well-drained	Acid	Pasture, hay, corn, oats


WASHINGTON
WARREN
LAKE GEORGE
GLENS FALLS
SARATOGA
TROY
ALBANY
SCHENECTADY
ALBANY
HAMILTON
FULTON
MONTGOMERY
SCHOHARIE

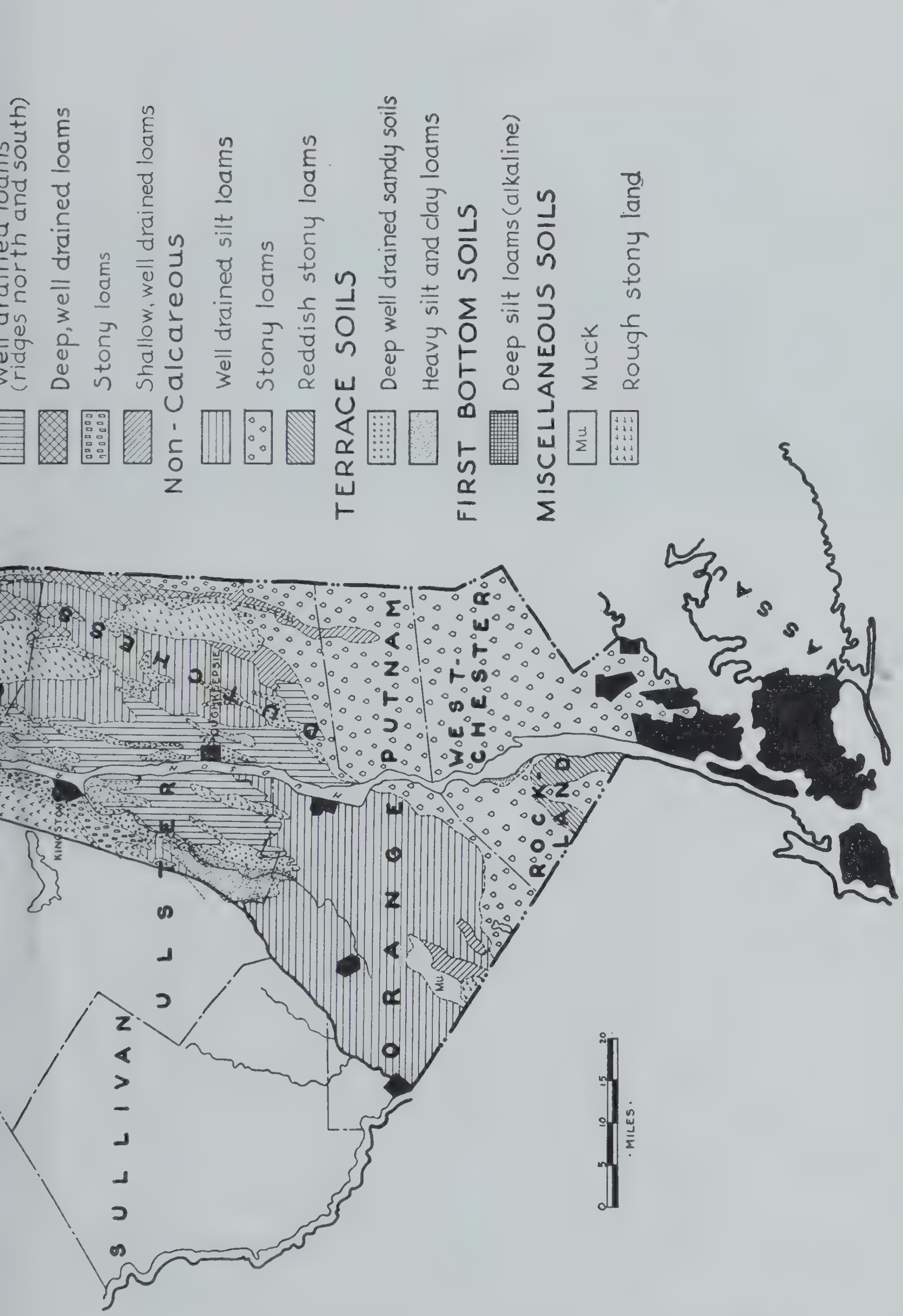


Figure 10. Generalized soil map of southeastern New York

The characteristics and crop adaptations of the soils of southeastern New York are given in the tabulation on pages 14 and 15. Except for the final column, this was prepared by F. B. Howe, who is in charge of the state soil survey.

THE LIME NEEDS OF SOUTHEASTERN NEW YORK SOILS

The need of red clover for lime varies considerably for the different soil types in the area. According to table 4, some of the soils contain considerable lime while others are low in calcium and magnesium. When soil is low in lime it is undoubtedly rather acid, and consequently in need of liming for good growth of clover.

The study of the soils in preparation for the writing of this bulletin included the collection of many samples representing the important soils of this area. These soils were taken to the laboratory at Ithaca, dried,

TABLE 5. HYDROGEN-ION CONCENTRATION, pH, AND ESTIMATED LIME REQUIREMENT FOR RED CLOVER OF SOILS IN SOUTHEASTERN NEW YORK

Soil	Range in pH*		Range in lime requirement for red clover (tons per acre)§
	Surface†	Subsoil‡	
Albia gravelly loam	5.5	5.2	¾
Allis shale loam	4.9	4.3	1¼
Alps gravelly silt loam	4.8	4.9	1¼
Bernardstown gravelly loam	5.2–5.3	5.4–6.9	1
Boynton gravelly silt loam	5.1–5.2	4.7–5.7	1
Claverack fine sandy loam	5.8–6.0	5.4–5.8	¼–¾
Copake loam	5.0–5.8	5.0–6.6	½–1
Cossayuna gravelly loam	4.7–5.9	5.1–7.1	½–1
Culvers gravelly loam	4.8	6.3	1¼
Dover loam	5.0–7.8	5.1–8.5	None–1
Dutchess loam	4.9–5.6	5.1–6.0	¾–1¼
Genesee loam	5.5–6.4	5.9–6.6	¼–1
Ghent silty clay loam	6.5	7.2	None
Gloucester stony loam	5.0–5.4	5.4–5.8	¾–1
Gloucester fine sandy loam	4.7–4.8	4.8–5.0	1¼–1½
Groton gravelly loam	5.1–5.7	5.3–6.3	¾–1
Hermon stony loam	4.7–4.9	5.1–5.2	1 –1¼
Hinckley gravelly loam	5.1	5.6	1
Hoosic fine sandy loam and loam	4.7–6.1	5.1–7.4	½–1
Hoosic gravelly loam	5.0–6.0	5.3–6.0	¼–1
Hudson silt and clay loams	4.7–6.1	5.0–8.0	½–1
Livingston silty clay loam	5.6–6.4	7.5–8.4	None–½
Lyons silty clay loam	6.7	8.2	None
Mansfield silty clay loam	5.5–5.9	6.8–8.2	½–1
Merrimac gravelly loam	4.8–5.4	5.7	1 –1¼
Muck	5.8–6.2	5.1–5.2	....
Nassau shale loam	5.1–5.5	4.8	¾–1
Ondawa loam and silt loam	5.2–7.0	5.3–8.0	None–1
Orono silt loam	7.3	6.4	None
Otisville gravelly loam	5.1–7.3	4.9–7.7	½–1
Pittsfield loam‖	5.0–7.8	5.1–8.5	None–1
Podunk silt loam	6.9	6.8	None–1
Saco silty clay loam	5.7–6.5	6.3–6.6	None–1¼
Schodack gravelly loam	4.7–4.9	5.0–5.4	1
Stockbridge loam	5.0–7.5	5.1–8.3	None–¾
Troy gravelly loam	5.2	5.6	¾
Vergennes soils	5.2–5.5	5.6–8.4	1 –1½
Walton gravelly loam	4.9–5.5	4.8	¾–1¼
Weathersfield fine sandy loam	4.6–5.2	4.5–4.6	1¼
Woodbridge gravelly loam	4.7–5.3	5.1–5.3	1 –1¼

*Hydrogen-ion concentration, or pH, is the degree of acidity of the soil. A soil with a pH of 7.0 is neutral, while a pH figure of 7.5 is alkaline, and one of 5.5 is acid.

†Surface soil about 0–6 inches.

‡Subsoil, 18–24 inches.

§Expressed as tons of high-grade finely ground limestone to the acre. Lime requirement is estimated by means of the potassium thiocyanate test by comparing with "standard" soils whose lime requirement is known.

‖Mapped Dover in Dutchess and Washington Counties and in the White Plains Area.

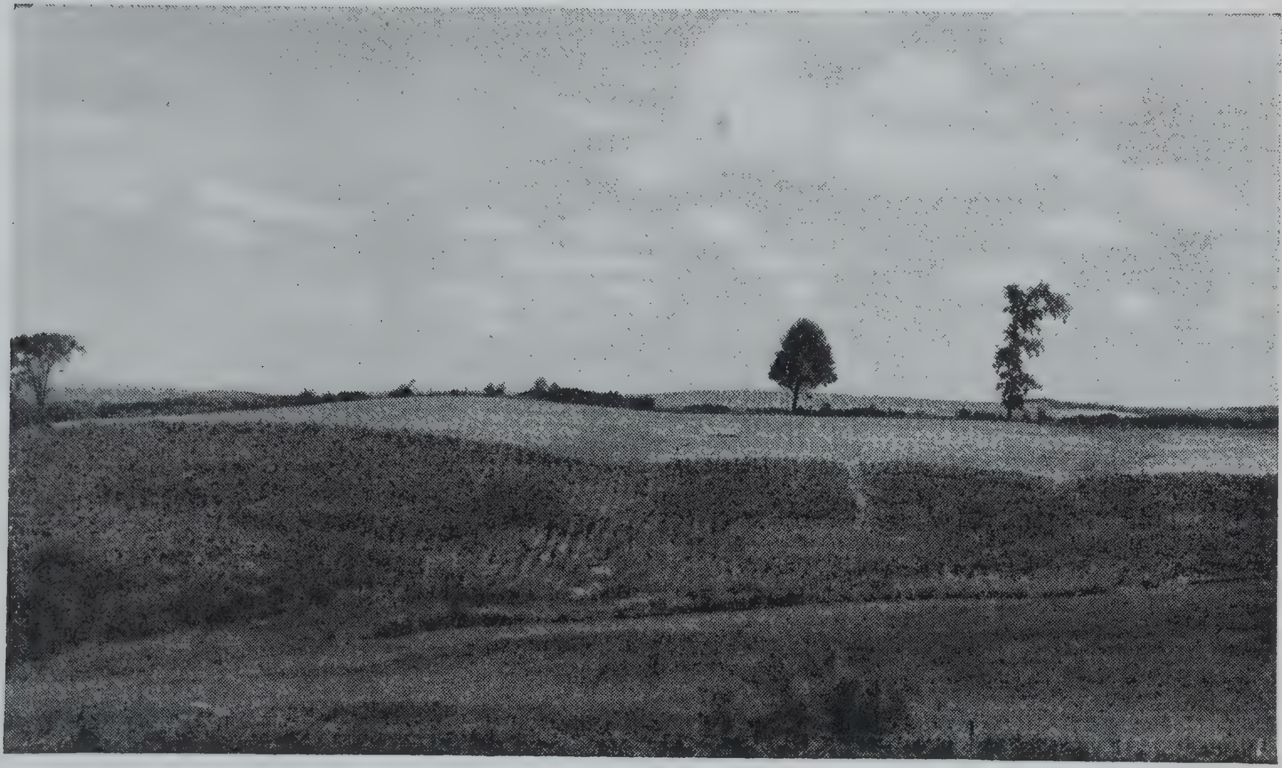


FIGURE 11. EROSION CAUSED BY CONCENTRATION OF WATER ON SLOPE ABOVE PLANTED TO POTATOES (RENSSELAER COUNTY)

Water collected by the potato rows down the moderate slope caused the gullies across the corn. The small growth of the corn near the gullies indicates that the surface soil has been washed away

prepared, and tested for hydrogen-ion concentration and for lime requirement for clover. The data on pH given in table 5 may be useful to growers of cabbage, potatoes, and other vegetables.

In this table are shown variations in lime requirement and pH within a soil type, but usually there is fairly good uniformity. Some variation may be explained by differences in treatment of the soil because these samples were collected from actively-farmed fields in so far as possible. Lime requirements of less than one-half ton are given to complete the picture of relationship between pH and lime requirement, but it is not intended to recommend that less than one-half ton be applied for clover. Where less than one-half ton is required, the deficiency may be taken care of by somewhat heavier than usual use of superphosphate and by top-dressing the new seeding with manure.

In table 5 is given the approximate lime requirement for clover on certain soil types; however, ordinary variations in soils should not be overlooked. The soils of different fields should be sampled and tested for lime requirement for red clover. Sampling to determine the adaptability of a soil for alfalfa and testing the samples for lime requirement for this crop are essential.[1]

SOIL EROSION IN SOUTHEASTERN NEW YORK

The surface soil is the first to be lost by washing, or erosion.[2] Since this soil layer is the richest in organic matter and plant nutrients, its

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[1] The county agricultural agent has equipment for sampling soils and for estimating their lime requirement for alfalfa and clover. He will advise as to the kind and quantity of lime to be used, if any is needed.

[2] Additional information on the subject is given in *The Control of Soil Erosion in New York* by A. F. Gustafson (Cornell ext. bul. 438, 1940).

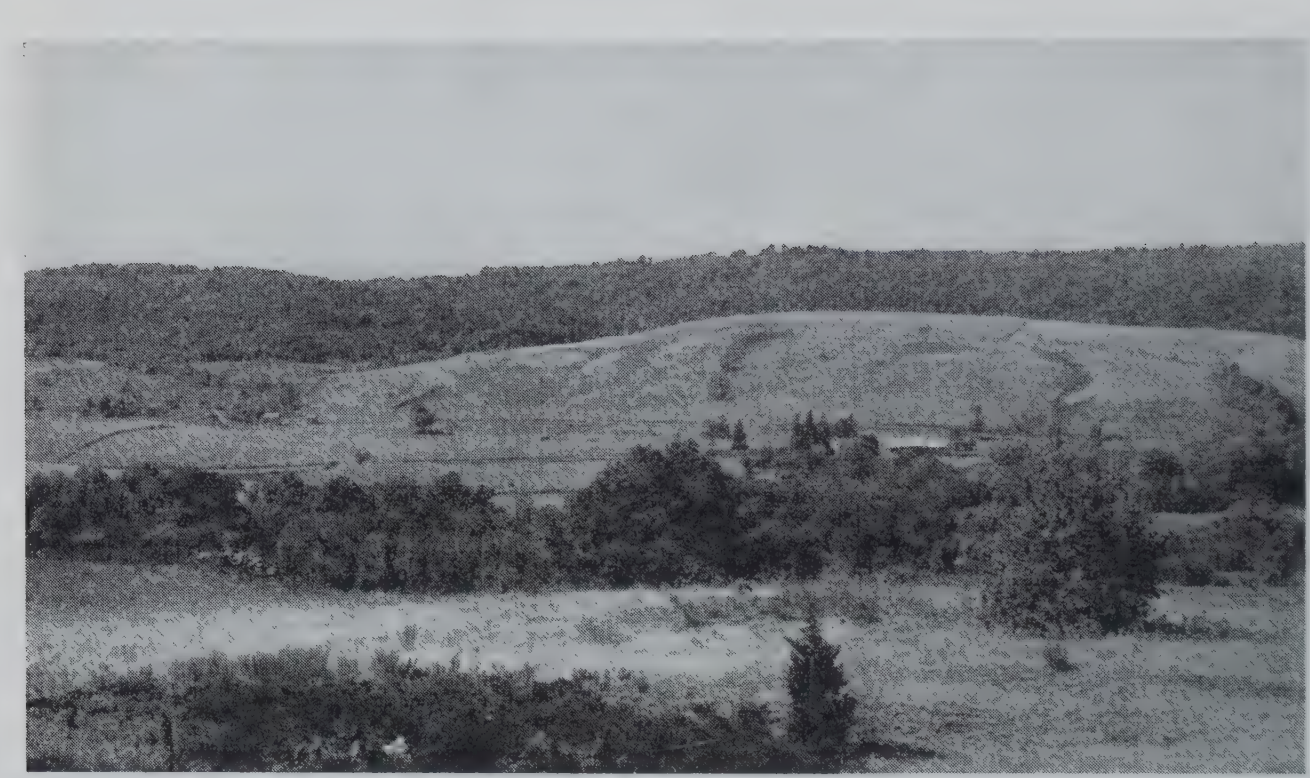

FIGURE 12. EROSION ON BERNARDSTOWN GRAVELLY LOAM

The hill in the center, which is immediately south of West Taghkanic, was badly gulleyed, and cropping was abandoned some years ago. The gulleys have become sodded so that erosion is no longer active. Slopes as steep as this should be kept permanently in grass

loss is bound to materially reduce crop yields. In fact, the sloping soils of this area have suffered greater permanent injury from soil erosion than from any other cause, either natural or induced by man (figures 11, 12, and 13).

Erosion may be expected to occur on moderate to steep slopes in the hill section and on all slopes of the Hudson soil types and on slopes of such strictly upland soils on the general Hudson lowland as the Cossayuna and Pittsfield. Erosion occurs on steep slopes of the Otisville and Groton soils. Damage from erosion is seldom serious on the gravelly soils such as the Hoosic, Claverack, Copake, and Merrimac, or on the nearly level phases of the Hudson soils.

Methods recommended for controlling soil erosion in southeastern New York. For all of the steeply sloping upland soils and for the slopes of the Hudson soils, nature's own forest growth is the best agent for the control of erosion. Next best is a good thick pasture sward or a thick stand of meadow grasses or small grains. Pasture may be employed to real advantage on rather steep slopes, and meadow on slopes that are not too steep for the carrying on of the regular operations of hay making.

On land that is being cultivated, the following suggestions and recommendations may be helpful:

1. Plow, plant, and cultivate intertilled crops across or around rather than up and down the slope, in so far as feasible.
2. Drill grains and meadow seedings around or across the slope.
3. Keep up the organic-matter content of the soil by growing clover, and by returning organic matter in the form of manure as generally as possible, and green manures wherever feasible.

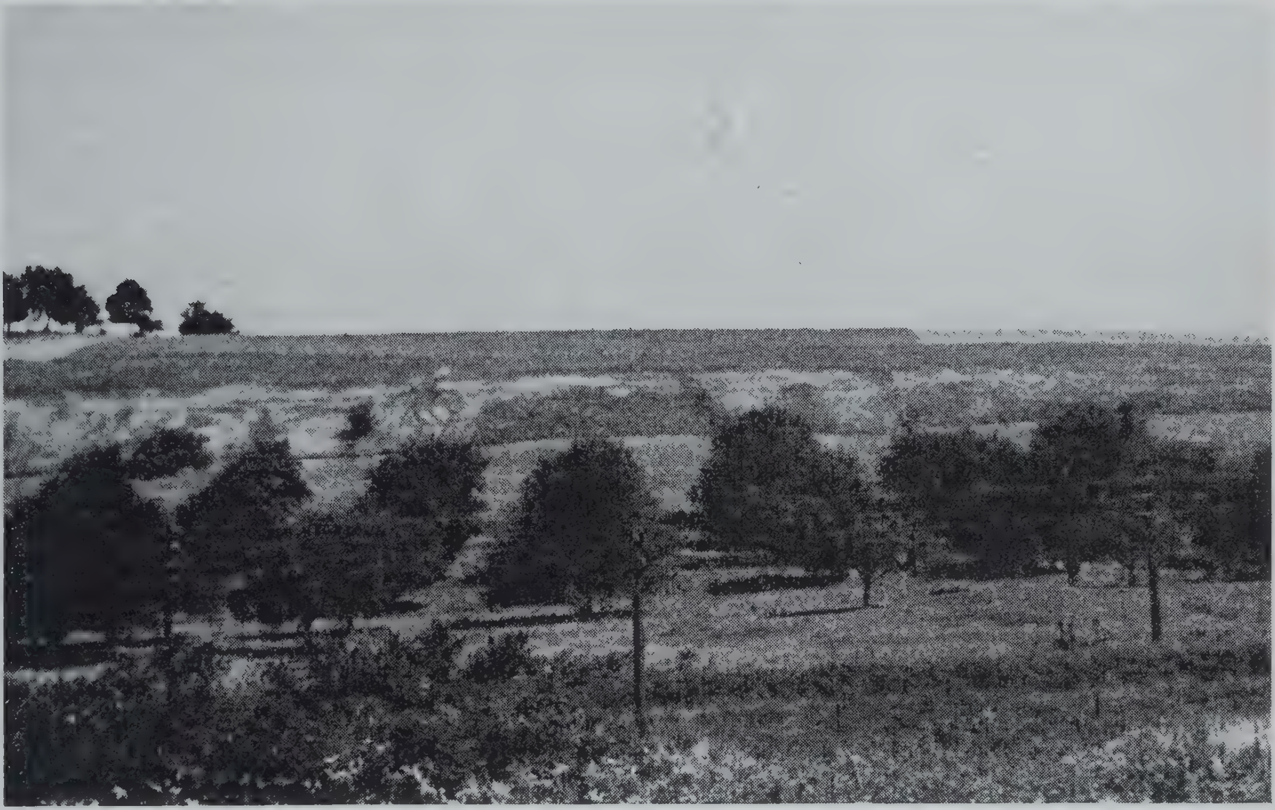

FIGURE 13. EROSION NEAR CHATHAM, COLUMBIA COUNTY

4. Use lime if needed for clover and superphosphate as suggested in the section on rotations (page 24). These are very helpful in producing large root systems, good soil cover, and good yields. Large, fibrous root systems hold the soil together and thus aid in controlling erosion.
5. Keep all moderate to steep slopes under the protection of vegetation, such as hay or pasture grasses and forest.

PRODUCTION OF FARM MANURE

Owing to the variation in the agriculture of the different sections of this area, the quantity of manure produced to the farm is highly variable. Farms range in size from an average of 33 acres in the fruit section, to 225 acres in dairy-farming areas. Since few animals are kept on the fruit farms, little manure is produced on these. On the other hand, in a dairy section with large farms and good-sized dairy herds the annual production of manure is 200 tons on many farms, and exceeds this quantity on the larger farms. In general, the farms are small in the fruit belt and in the hill sections. Dairying is carried on generally in the hill section; consequently farms in that area are the ones moderately well supplied with manure. On the fruit-belt farms, on the other hand, far more manure could be used to advantage than is produced there.

Unfortunately the full value of manure is not always recognized by farmers. An average ton of farm manure contains 10 pounds each of nitrogen and potash, and 5 of phosphoric acid. A farm that produces 200 tons of manure a year, therefore, has a little fertilizer factory all its own, since that quantity of manure contains 2000 pounds of nitrogen, 1000 of phosphoric acid, and 2000 pounds of potash. These quantities of total nitrogen and potash are equivalent to those in 20 tons of a 5–10–5 fertilizer,[3] and that of phosphoric acid to that in 2½ tons of 20-per-cent superphosphate. It should be considered, however, that the plant nutrients in manure are, as a whole, less readily available than are those in commercial fertilizer; yet much of the nitrogen and a considerable part of the phosphorus and potash in manure becomes available during the growing season for which it is applied.

In applying manure at the rate of 10 loads to the acre, 100 pounds each of nitrogen and potash and 50 pounds of phosphoric acid go onto each acre. This quantity of nitrogen and potash is equivalent to that in 2000 pounds of a 5–10–5 fertilizer, and the quantity of phosphoric acid is equal to that in 250 pounds of 20-per-cent superphosphate. Therefore, a 20-ton application of manure, which is not unusual, is a heavy application of nitrogen and potash.

These rates of application of plant nutrients in commercial fertilizers are, of course, far higher than farmers normally make for feed crops, but too often the results from such applications are compared with those from the use of about 200 pounds to an acre of a factory-mixed fertilizer or of superphosphate. These figures explain the reason for the apparent greater effectiveness of manure than of fertilizers in producing crops.

Both nitrogen and potash may easily be lost from manure. Experimental work shows least loss of nutrients and largest increases in yield from the use of manure when it is hauled to the field and spread daily.

Losses in value of manure in storage are very great. At Ithaca, horse manure placed in an open pile in late April and weighed and analyzed again early in October had lost 57 per cent of its organic matter, 60 per cent of its nitrogen, 47 per cent of its phosphorus, and 76 per cent of its potash. For cow manure the loss was 49 per cent of its organic matter, 41 per cent of its nitrogen, 19 per cent of its phosphorus, and 8 per cent of its potash. Similar losses may be expected when manure is stored over summer in a loose pile.

Because these severe losses may be expected, it seems wise to store manure under cover whenever possible, or in a deep flat-topped pile with a slight slope toward the center. When this is done the rain falling on the pile is taken up by the manure, and this keeps it moist and reduces the extent of rotting. Since the pile is from 4 to 6 feet deep or more the water falling on it is retained and leaching is avoided. It is usually best, however, to haul out fresh manure and spread it daily. Losses are lowest when manure is used in this way.

Recommended usage of manure. The crop increases produced by manure depend on the rate of application, or the number of tons used to the acre. It has been shown clearly that moderate applications, such as 8 or 10 loads to the acre, give much larger returns from the manure used than do heavier applications, such as 20 to 30 loads to the acre. Obviously twice as many acres can be given 10 loads from a given quantity of manure as can receive 20 loads to the acre. Or one can manure the whole farm twice as often with the lower, as with the higher rate of application. If 10 loads can be put on once in four years it will be eight years between 20-load applications. The lighter, more frequent applications of manure are the more desirable and more profitable.

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[3] A 5–10–5 fertilizer is one that carries 5 per cent of nitrogen, or 5 pounds in a hundred, or 100 pounds of nitrogen in a ton. It carries the same quantities of water-soluble potash and 10 per cent, or 200 pounds, of available phosphoric acid in a ton of fertilizer.

As already indicated, manure is relatively low in phosphorus. For feed crops, manure should be supplemented with phosphorus. The most economical way to do this is by adding for each cow 1 to 2 pounds a day of inexpensive 20-per-cent superphosphate or its equivalent in other analyses[4] to the manure in the barn. This is from 300 to 600 pounds of superphosphate to the acre if 10 tons of manure is used. It is then spread with the manure, thus avoiding the labor cost of applying the superphosphate separately.

Another, but less satisfactory, way is to put superphosphate on the load of manure just before it goes to the field. Or the superphosphate may be drilled onto manured land at seeding time.

FERTILIZER EXPERIMENTS

The experiments made with soil types in this area included Dutchess silt loam from Dutchess and Orange Counties.[5] Applications of nitrogen, phosphorus, and potash gave a goodly increase in yield of feed crops. Complete fertilization and liming produced an average yield of feed crops on these two Dutchess soils that was more than four times the yield of the untreated soils. Liming alone nearly trebled the yield. Phosphorus alone increased yields by one-fifth; potash used alone increased yields by one-third; and nitrogen increased the yields of feed crops by one-half on these two Dutchess soils.

On the Vergennes soil phosphorus raised the yield one-fifth; potash had no effect; but nitrogen increased the yield of feed crops nearly one-half.

On the Dutchess soils feed crops may pay for the nitrogen used, near New York City, on hay because it is a bulky product on which carrying charges are relatively heavy. On the Vergennes soils, however, in Washington and Saratoga Counties, one cannot expect the use of commercial nitrogen to prove profitable on hay crops under average prices for hay and dairy products. In this area on Vergennes soils farm manure and legumes must be depended on mainly to supply feed crops with the needed nitrogen.[6]

Phosphorus, as indicated in table 4, page 13, is rather deficient in many of the important soils of southeastern New York. Some soils are particularly deficient in phosphorus in the subsurface and the upper subsoil. Manure furnishes minor quantities of phosphorus, but the only other way to add it to the soil is to buy it, usually as superphosphate or mixed fertilizer. Many indications of lack of phosphorus available to crops may be noted throughout the area from the appearance and growth of plants.

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[4] The 20-per-cent superphosphate is meant when the percentage is not specified. Higher-analysis superphosphates which are on the market are perfectly satisfactory. Five hundred pounds of 16-per-cent, 400 pounds of 20-per-cent, 250 pounds of 32-per-cent, and 200 pounds of 40-per-cent superphosphates all supply exactly the same quantity of actual phosphorus.

[5] *Fertilizer tests for several soil types*, by T. L. Lyon, Cornell Univ. Agr. Exp. Sta., Bul. 520, 1931.

[6] Further information is given in *Legumes as a Source of Available Nitrogen in Crop Rotations*, by T. L. Lyon (Cornell Univ. Agr. Exp. Sta., Bul. 500, 1930).

Potash, as may be seen in table 4, is present in relative abundance on most of these soils. However, it is not always so readily available as might be desired. Manure supplies considerable potash, and in turn aids in making potash from the soil available to plants.

FERTILIZER RECOMMENDATIONS

For feed crops on many dairy farms the principal fertilizer element that must be purchased is phosphorus, usually in the form of superphosphate. Clover, alfalfa, or other legumes should be grown freely in the rotation for producing high-protein roughage and for supplying nitrogen to grass and grain crops. It usually pays to inoculate the legumes. In special cases a mixed fertilizer high in phosphorus, such as a 4–16–4 or 5–20–5 might be justified.

For potatoes, sweet corn, and other vegetable crops, a complete fertilizer usually gives best results.[7] Fertilizer recommendations for these crops are given in Cornell extention bulletin 281.

While many different mixed fertilizers are used in the area, superphosphate and three mixed fertilizers will satisfy the important fertilizer needs of the crops grown in the area, with the exception of fruit.

These fertilizers are the 5–20–5 and 10–20–10 or other mixtures carrying the same ratios of plant nutrients. For example the 5–10–5, 8–16–8, and 10–20–10 all have the same ratio, or 1–2–1; that is, these mixtures carry twice as much of phosphoric acid as of nitrogen and potash. Reducing the number of analyses of fertilizer on the market will save money for both the fertilizer manufacturer and the farmer.

ROTATION OF CROPS

The value of manure, lime, fertilizers, and good tillage[8] has been recognized by farmers for many years, but the benefits that may be derived from following a rather regular rotation of crops suited to the climate, to the soil, and to the prevailing type of farming are not fully understood nor fully appreciated. Growing crops including a legume in a regular order helps to keep up, or to increase, crop yields. It should be emphasized that the increased yields resulting from properly rotating crops are obtained in addition to increases resulting from the use of manure, fertilizer, and lime, and from suitable tillage. A crop following a legume is benefited by the nitrogen fixed by it and left in the soil when the legume is plowed under. Furthermore, growing crops in fairly regular order and plowing at regular intervals help in keeping weeds under control, particularly those that thrive in meadows.

RECOMMENDED ROTATIONS AND FERTILIZATION FOR GRAIN AND FORAGE CROPS

Rotation 1. *For Dutchess, Cossayuna, Pittsfield, Bernardstown, Stockbridge, and minor soils in the hill area*

First year. Corn: 10 loads of manure supplemented with superphosphate in the stable, as already suggested, or from 50 to 60 pounds of 20-

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[7] Valuable detailed information on fertilizers is given in *Fertilizer Recommendations for New York* (Cornell ext. bul. 281, 1929).

[8] Helpful information along this line is given in *Drainage, Plowing, Seedbed Preparation, and Cultivation in New York,* by A. F. Gustafson, Cornell ext. bul. 183, 1938.

per-cent superphosphate to the load as the manure goes to the field. This treatment is sufficient for a 4-year rotation of feed crops. As the quantity of manure to the acre is varied, a corresponding change should be made in the quantity of superphosphate used to the load. At least 150 pounds of 20-per-cent superphosphate should be used to the acre a year as a minimum average over the period of the rotation. Since these soils are very low in native phosphorus, it is especially important that phosphorus be used regularly.

If it is more convenient to use about 300 pounds of 20-per-cent superphosphate at seeding time for corn and the same quantity for oats, that method of fertilizing the rotation also is satisfactory.

Second year. Oats: a mixture of oats and barley may be preferred on the higher elevations.

No treatment except liming as needed for clover, if full superphosphate treatment was used for corn. If only 300 pounds was used for corn, a similar quantity is needed for oats.

Third year. Clover[9] and timothy:[10] no treatment unless sufficient manure is available to permit of an application of about 8 loads to the acre.

Fourth year. Timothy and other grasses and clover: ordinarily no treatment is needed, since timothy usually makes a good yield the first year after clover.

A long-lived or a perennial legume is needed in most meadow mixtures. Alfalfa serves this need on the well-drained soils that are sufficiently supplied with lime or on which an abundance of lime has been applied. The successes that have been reported in southeastern New York from seeding ladino clover with grasses on productive soils that have sufficient lime, prompt the suggestion that ladino clover might be tried out in a modest way. In places, ladino has given a good yield for one or even two years after red clover has gone out. The seed of ladino clover is high in price, but small in size, so that a small quantity of seed goes a long way.

On lands not so favorably located or less easily tilled owing to stones, rock ledges, or lack of good drainage, it is feasible to leave the land in grass for some additional years. When this is planned for, two things are essential: the application of 20-per-cent superphosphate up to the average of 150 pounds an acre a year, and frequent light applications of manure if legumes are not growing well. Eight loads to the acre, with 50 or 60 pounds of 20-per-cent superphosphate to the load, put on every three years helps greatly in keeping timothy clean and productive. Since the manure spreader tears up the manure as it spreads it, the use of this implement gives best results in manuring meadows. This fertilizer treatment is inexpensive when returns are considered, and it improves the mineral balance of the resulting hay for feeding purposes.

If the roots should be heaved badly it is better to plow up and reseed; otherwise the yield will be seriously reduced.

On all of the well-drained soils, alfalfa may well be sown in the meadow mixture at a rate of at least 5 pounds to the acre, in addition to red clover. It is not likely to pay to seed any alfalfa on poorly drained soils or those underlain with hardpan or shale near the surface.

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[9] For further information see *Seventy-six Clover Questions Answered*, by H. B. Hartwig, Cornell ext. bul. 210, 1931. Also, *The Effect of Some Legumes on the Yields of Succeeding Crops*, by T. L. Lyon, Cornell Univ. Agr. Exp. Sta., Bul. 447, 1925.

[10] Helpful details are given in *Meadow Improvement Through Seeding, Fertilization, and Management of Meadows*, by A. F. Gustafson, Cornell ext. bul. 181, revised 1937.

Sometimes it may be desired to cut timothy beyond the fourth year of the rotation. If the grass contains little or no alfalfa or other legumes and if manure is not available, commercial nitrogen may be used to advantage on some farms. This is more often true near cities or where hay is purchased regularly. Good thick stands of grass can be kept productive by applying nitrogen or a complete fertilizer if insufficient phosphorus was put on for the rotation before seeding the meadow mixture. An application of 200 pounds of nitrate of soda or 150 pounds of sulfate of ammonia or 100 pounds of uramon should prove exceedingly helpful for the meadow grasses. Similar, or even somewhat larger, quantities of nitrogen may be applied in other carriers of this element.

Millet or sudan grass may be used in rotation 1 in place of corn. These crops seldom yield as much feed as corn does on good soils but they serve well as green feed or for hay. Under favorable soil conditions these annual hay crops thrive when fertilized as suggested for corn.

Rotation 2. *For areas where it is not desired to grow corn*

First year. Oats: lime as needed for clover and 400 to 500 pounds of 20-per-cent superphosphate to the acre.

Second year. Clover and timothy: no treatment.

Third year. Timothy and clover: no treatment.

Fourth year. Timothy: 8 loads of superphosphated manure to the acre, with 60 pounds of 20-per-cent superphosphate to the load. Repeat the manure-superphosphate treatment every three years, or every two, if the supply of manure is sufficient. The quantity of superphosphate to the load is adjusted so as to apply not less than an annual average of 150 pounds a year to the acre for the rotation.

On the Hudson lowland, fruit and vegetables should have first consideration in the section and on the soil types adapted to them, such as the Hoosic, Cossayuna, and associated Pittsfield and Claverack, and to a small degree the Hudson fine sandy loam. On well-drained soils in the fruit belt not occupied by fruit or vegetables, alfalfa should have first consideration. If there is sufficient acreage for a rotation, a good one is: first year, corn, second year, oats, and alfalfa following the oats, to continue as long as it cuts good crops or until the land is needed for corn. Corn and oats may be treated as suggested for them in rotation 1. Not less than an average of 150 pounds of 20-per-cent superphosphate an acre a year should be used for alfalfa, since it feeds heavily on phosphorus.

The heavy Hudson types are better adapted for the production of hay and pasture grasses than for corn or small grain. Rotation 2 may be suitable under many conditions. Special attention should be given to the question of heaving of timothy. A good aftermath cover helps in reducing alternate freezing and thawing and consequent heaving. If this can be controlled, fairly long-term meadows of timothy are probably the best use of the Hudson and other heavy or somewhat poorly drained soils.

RECOMMENDED VARIETIES AND RATES OF SEEDING

Corn. Cornell 29–3 is the best variety for silage on the highest elevations and for grain on the medium elevations. West Branch Sweepstakes is a good variety for silage on the Hudson lowland and up to elevations of about 1200 feet in the hills, and Cornell 11 at higher elevations. Both West Branch and Cornell 11 do best on "strong land". Both respond to the use of manure and superphosphate in southeastern New York.

Spring grain. Cornellian and Llenroc oats are the varieties recommended. A common rate of seeding is 8 pecks to the acre, but on "strong" land or where a heavy application of manure was made for the preceding crop, a seeding of 6 pecks may stand up better and yield more grain, especially in a wet season, than will an 8-peck seeding. Superphosphate applied heavily direct for oats should help to reduce lodging and to improve yields, and at the same time materially benefit the meadow seeding.

In situations where lodging is expected to be particularly serious, the Upright variety of oats is preferable to the others.

Meadow seeding mixtures. Under average conditions as to depth of soil and drainage on the Dutchess, Pittsfield, Bernardstown, Stockbridge, Cossayuna, and other soils, a good rate of seeding is 6 pounds of red clover, 4 of alsike, and 8 pounds of timothy to the acre. The red-clover seed should be hardy, northern-grown, domestic. It may need inoculation before being sown. Lime as needed, according to test of the soil, should be applied and thoroughly mixed with the soil before seeding. The lime requirements shown in table 4 are suggestive of the quantities likely to be needed for red clover.

On the gravelly and other well-drained soils such as Pittsfield or Dover, Troy, Albia, Hoosic, Merrimac, Cossayuna, Schodack, Claverack, and Copake, after liming sufficiently for it, 6 pounds of variegated, inoculated alfalfa may well replace the alsike clover in the above mixture.

On rather poorly drained areas that remain moist throughout the season, 6 to 8 pounds of alsike with 5 pounds each of timothy and redtop should produce fairly good hay. In time the timothy is likely to be displaced by redtop under these conditions.

On the Hudson silty clay loam and silt loam which may be rather wet in the spring and which becomes bone-dry in periods of low summer rainfall, mammoth clover, 8–10 pounds, and timothy 8 pounds to the acre, should prove a good meadow mixture, particularly on the less productive areas.

Alfalfa. The Hoosic, Cossayuna, Copake, Groton, Schodack, Otisville, Albia, Troy, Pittsfield or Dover, Merrimac, and Hinckley soils are generally well adapted for the growth of alfalfa. The Hoosic loam, where it joins the Hudson soils, and parts of the Claverack do not possess the subsoil drainage needed for alfalfa. Much of the Cossayuna, Pittsfield, and some of the Dutchess and other upland soils will carry alfalfa to good advantage. With the exception of some areas of Pittsfield soil, all of these soils require some lime for alfalfa. If more than 1½ tons is needed, the application should be divided, half being applied for the cultivated crop a year before plowing for alfalfa, and the remainder applied soon after plowing and stirred into the soil while preparing the seedbed for this crop. In this way the acidity is reduced sufficiently for alfalfa by the time it is seeded.

Ontario variegated and Grimm alfalfa may be expected to give best results over a period of years. Fifteen pounds of well-inoculated seed to the acre usually gives a good stand of alfalfa. For farm feed, 10 to 12 pounds of alfalfa, with 5 pounds of timothy in addition, gives good results. Alfalfa may be seeded in June or July in the northern part of this area on well-prepared comparatively weed-free land, or in Cornellian oats sown at the rate of 5 or 6 pecks to the acre. Removing the oats for hay where possible is beneficial to the alfalfa. In the southern counties, seeding in late July and early August gives good stands.

Since alfalfa feeds heavily on phosphorus, this element should be supplied at a rate of not less than 150 pounds of 20-per-cent superphosphate to the acre a year, on the average, for the life of the stand. On soils well adapted for alfalfa, 400 to 600 pounds of 20-per-cent superphosphate to the acre at seeding time is a good application. The heavier rate usually produces more alfalfa than does the lighter one.

Except where the soil has been manured consistently over a period of years, 100 pounds of muriate of potash at seeding time and repeated every two or three years afterward is good practice on the more gravelly soils such as Hoosic, Copake, Claverack, Merrimac, Hinckley, Groton, Schodack, Troy, Albia, and Otisville.

Buckwheat. The acreage of buckwheat has declined markedly in recent years, the present acreage being unimportant. Buckwheat needs phosphorus; about 150 pounds of 20-per-cent superphosphate to the acre is a good application. Manuring direct for buckwheat usually causes lodging. The crop occupies the same place that corn does in the rotation. Buckwheat needs 10 to 12 weeks from planting to maturity. The Japanese, common gray, and Silverhull varieties yield in the order stated. The usual rate of seeding is 4 or 5 pecks to the acre for Japanese, and 3 pecks to the acre of the other varieties. Buckwheat does not control soil erosion as effectively on fairly steep slopes as do oats, meadow, or pasture, and is seldom a profitable crop.

Soybeans. The Cayuga soybean can be of real service to southeastern New York dairymen. Under conditions favorable for it, it produces a goodly yield of beans, the meal of which is high in protein and in oil. The protein and oil in soybean meal are equal to or higher than in either cottonseed or linseed meal. When mixed with oats and corn and ground, soybeans supply the protein needed in dairy rations.

Soybeans require the same seedbed and soil conditions as does corn, and liming approximately as for red clover. Soybeans are planted some days after corn-planting time, since they require a warm soil for germination and growth. The Cayuga variety may be grown on the Hudson lowland and in favorable locations on the lower upland. The Black Eyebrow and Manchu may do even better than the Cayuga on the Hudson lowland, but they need a growing season extending up to October 1. In table 1 are indicated the average date for the first killing frost and the earliest killing-frost date. These dates and the length of the growing season may determine the soybean variety to use.

The Cayuga soybean is the one variety recommended for the higher

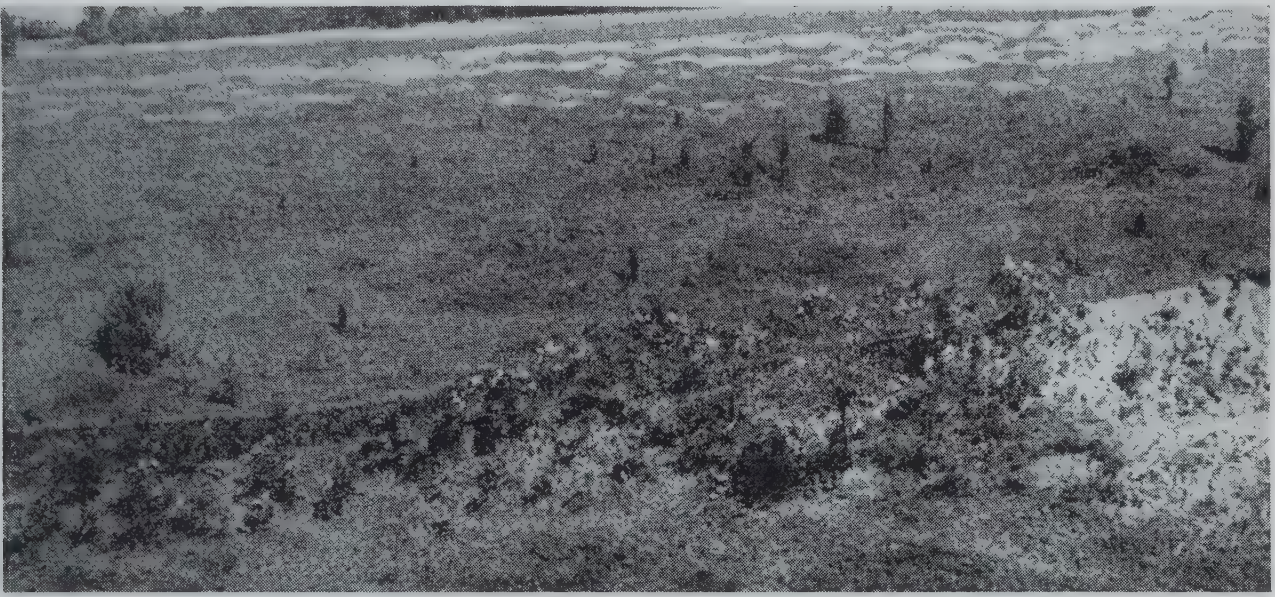

Figure 14. slipping of the hudson clay (background) in a columbia county pasture

elevations at present in the central Hudson Valley. On clean land it is drilled solid; that is, all drill holes open, at the rate of 6 to 8 pecks to the acre. On weedy land, planting less seed in rows 28 inches apart and cultivating are probably better practices. Special pains should always be taken to have the seedbed reasonably free of weeds before seeding. The seed requires inoculation before planting. When drilled solid the beans may be cultivated with a weeder or a peg-toothed harrow during the hot dry part of the day, when the plants are tough and resistant to injury.

PASTURES

Much of southeastern New York is particularly well adapted for the production of grasses for hay, for silage, and for pasture. The best lands no doubt produce better grass than do poor soils. Yet the most productive soil must be kept for growing the crops in which the farmer makes large investment in labor, seed, and soil treatment. Some land that is somewhat too poorly drained, or somewhat steeply sloping, or badly washed, or naturally not particularly productive may be taken out of cultivation. Such land may be used for grass. With proper treatment, seeding, and management these soils may be expected to yield good returns as pasture.

Like most crops, pasture grasses respond to good treatment. One or more legumes with the grasses are essential for good results. The pasture legumes, wild white clover, and ladino clover thrive on soils that are not very acid. On soils near or below a pH of 5.5, liming is essential for good growth of these legumes. They must make good growth, or they cannot supply the grasses with the nitrogen needed and the livestock with the protein required. Liming approximately as needed for red clover is good for these pasture legumes.

Legumes feed heavily on phosphorus, and without a plentiful supply of it they cannot make good growth. Applications of about 600 pounds an acre of 20-per-cent superphosphate repeated every four years are very beneficial after liming. The lime and phosphorus are equally beneficial to the livestock that grazes on pastures so treated.

A full discussion of pasture improvement and management is given in Cornell extension bulletin 393, by D. B. Johnstone-Wallace.

In seeding pastures the mixture should include such perennial legumes as wild white or ladino clover and long-lived perennial grasses such as Kentucky and Canada bluegrass, and timothy, orchard grass, and perennial rye grass.[11]

Wild bird's-foot trefoil is well established in the north central part of this area, particularly in Columbia and Albany Counties. Here the inclusion of a small quantity of wild bird's-foot trefoil seed appears to be well justified. Being a deep-rooting legume this plant does well even in droughty periods.

SPECIAL MANAGEMENT RECOMMENDED FOR GRAVELLY SOILS

The gravelly soils of southeastern New York include the Hoosic, Claverack, Copake, Troy, Albia, Merrimac, Schodack, Groton, and Otisville series. Much of the acreage of these soils is rather deficient in organic matter. This deficiency is especially marked in those areas which are growing orchard trees and which have been clean-cultivated over a considerable period of years, and also in those areas on which rye has been grown rather frequently. It is in the orchards on the coarser Hoosic soils in particular that this deficiency is showing its effect, owing to the inability of these soils to hold water (figure 6).

Everything feasible should be done to keep up a supply of active organic matter to aid these soils in holding water during periods of low summer rainfall. Such quantities of manure as are available should be applied to them, whether in orchard or other crops.

In orchards it may be necessary to go to the expense of seeding cover crops to be worked into the soil as organic matter. Rye, or rye and vetch, may be sown early in October, allowed to grow throughout the fall and early spring, and worked into the soil with a disc harrow the following spring. The growth of the cover crop should be stopped early enough so as not to use moisture that should be conserved for the use of the trees. Owing to the openness of these gravelly soils, green, succulent, organic matter decays and disappears from them rapidly. Consequently, it is essential that organic matter be turned under every year on these soils. Such organic matter may be expected to be of real value to the trees over a period of years.

If straw or other coarse material is available for a mulch under the trees, it is helpful in conserving moisture for the use of the trees.

In the younger orchards with much open space between the trees, alfalfa might be planted, but its probable competition with the trees for moisture should not be overlooked. The requirements of alfalfa have been outlined. If absolutely needed for the livestock, one crop might be removed for hay. The other crop, however, should be cut and forked over under the trees, where there is no alfalfa growing, to serve as a

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[11] Specific recommendations involving foreign seed cannot be made because of the present international situation. Current recommendations may be obtained from county agricultural agents or from extension agronomists.

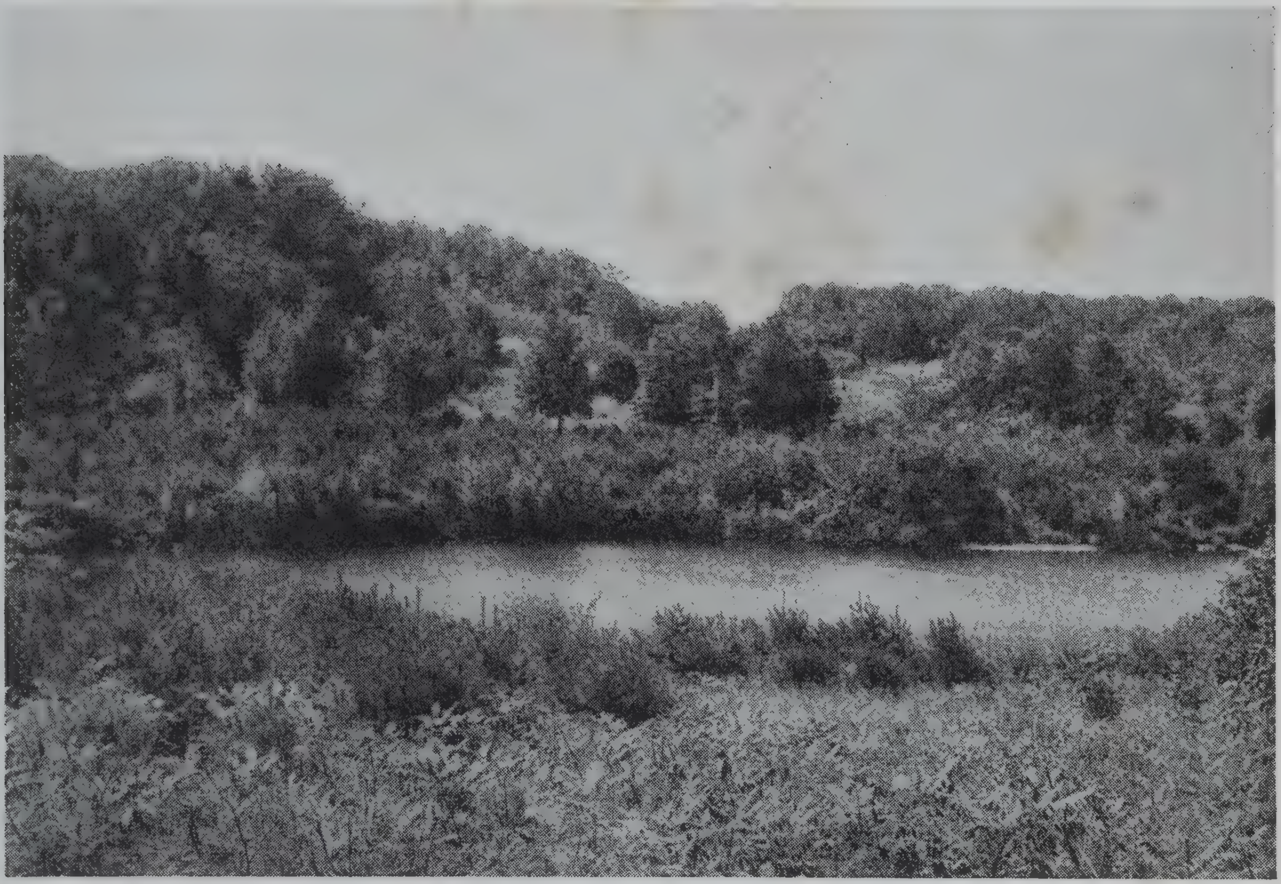

Figure 15. pines at the hudson city water reservoir

The pines bordering the far shore were planted to protect the soil against erosion, and are making good growth

mulch and as a source of nitrogen for the trees. The first cutting should be used for mulching purposes, and the second for hay. This fits the needs of the trees, and, moreover, the second cutting is more desirable for feeding purposes. Sweet clover may serve the same purpose in places.

Fruit growers in the area are referred to *Soils in Relation to Fruit Growing in New York;* Part VII, by L. P. Batjer and Joseph Oskamp (Cornell University Agricultural Experiment Station, Bulletin 627, 1935).

FORESTS AS A FARM CROP

In the hill section, private, as well as public reforestation, should be given serious attention. As the lands in pasture near the farm buildings are improved, the more distant and otherwise less accessible fields will not be needed unless the number of livestock on the farm is increased. The back fields, or those higher up, will be released by pasture improvement, and may be reforested. Information on tree planting, species adapted to various soil conditions, source of planting stock, and information on woodlot management may be obtained from county agricultural agents or from the extension foresters at the New York State College of Agriculture at Ithaca.

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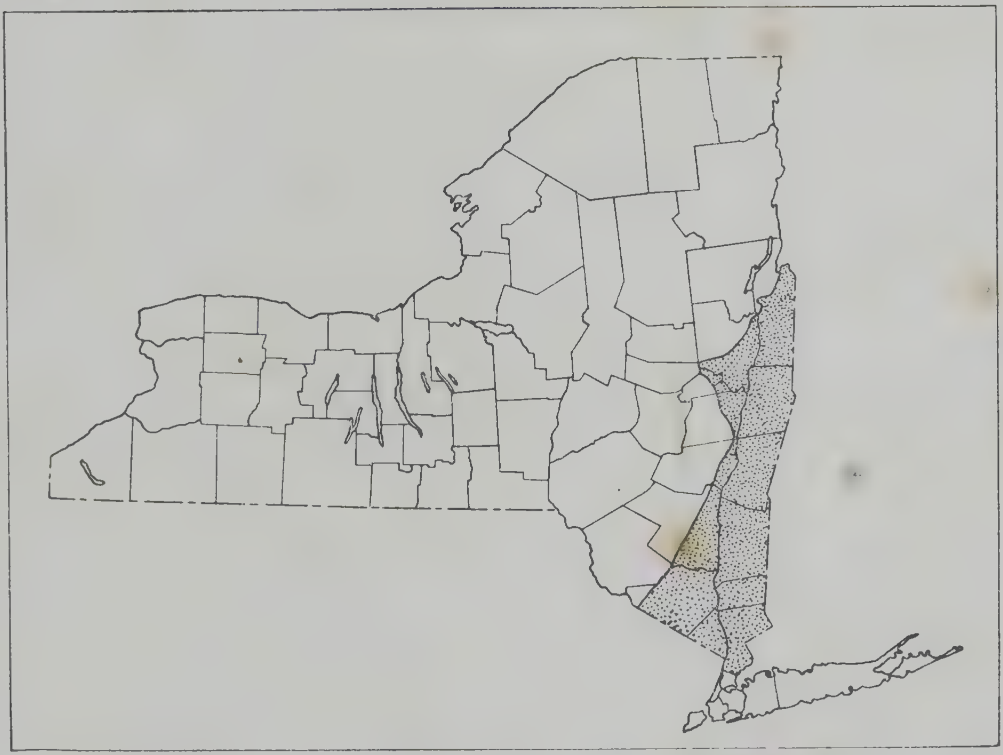
Soil and Field-Crop Management for Southeastern New York

A. F. Gustafson



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SOIL AND FIELD-CROP MANAGEMENT FOR SOUTHEASTERN NEW YORK

A. F. Gustafson

The southeastern New York area referred to in this publication is made up of Westchester, Putnam, Dutchess, Columbia, and Rensselaer Counties, and the southeastern part of Washington County on the east side of the Hudson River; and on the west side of the river, Rockland, nearly all of Orange, the southeastern part of Ulster, and the Hudson River bottom-land parts of Greene, Albany, and Saratoga Counties. This is shown on the map on the cover.

CLIMATE

The climate of southeastern New York varies rather widely. Temperatures are affected by the elevations, which vary from sea level to as much as 2700 feet. Summers are of moderate length and relatively cool, and winters are relatively long and cold, particularly on the higher elevations at the north.

The length of the frost-free period is 186 days at Middletown, 175 days at Troy, 174 at Albany, and 146 at Chatham. The relatively long frost-free period near the Hudson River is favorable for the fruit industry that is located near it (table 1).

TABLE 1. Average Killing-frost Dates At Weather Bureau Stations in Southeastern New York*

Station	Elevation	No. of years	Latest frost in spring			Earliest frost in fall			Average frost-free period (days)
			Earliest	Average	Latest	Earliest	Average	Latest	
Albany	97	57	Apr. 7	Apr. 24	May 30	Sept. 15	Oct. 15	Nov. 6	174
Bedford Hills	425	34	Apr. 2	May 1	May 30	Sept. 20	Oct. 13	Oct. 29	166
Carmel	500	35	Apr. 8	Apr. 28	May 12	Sept. 14	Oct. 14	Oct. 30	169
Chatham	470	16	Apr. 16	May 11	May 27	Sept. 11	Oct. 4	Oct. 26	146
Greenwich	425	16	Apr. 23	May 13	May 29	Sept. 15	Oct. 7	Oct. 22	147
Hudson	165	25	Apr. 11	Apr. 29	May 12	Sept. 15	Oct. 9	Oct. 27	163
Middletown	700	18	Apr. 1	Apr. 17	May 12	Sept. 22	Oct. 19	Nov. 5	186
Rhinebeck	215	10	Apr. 12	May 3	May 26	Sept. 11	Oct. 5	Oct. 19	155
Troy	35	15	Apr. 5	Apr. 24	May 11	Sept. 11	Oct. 16	Nov. 7	175

*The climate of New York. By R. A. Mordoff. Cornell Univ. Agr. Exp. Sta. Bul. 444. 1934.

In general, the growing-season rainfall is ample for the production of good yields of the crops usually grown throughout the area. Detailed climatic data are given in *The Climate of New York*, by R. A. Mordoff (Bulletin 444 of this Experiment Station, 1934). (Table 2.)

GENERAL TOPOGRAPHY AND DRAINAGE

Southeastern New York consists of two principal topographic areas, the Hudson lowland and the foothill-and-mountain area (figure 1). The Hudson area consists of two divisions: (1) the first bottom of the Hudson River, the total area of which is very small; (2) the nearly level plain,

TABLE 2. PRECIPITATION FOR POINTS IN SOUTHEASTERN NEW YORK*

Station	Period	January	February	March	April	May	June	July	August	September	October	November	December	Annual	Growing season†
	Years	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
Albany	105	2.51	2.43	2.73	2.73	3.33	3.85	3.88	3.72	3.28	3.22	2.93	2.57	37.18	18.06
Bedford Hills	40	3.55	3.47	3.46	3.48	3.98	3.67	4.63	4.66	3.81	3.68	3.40	3.56	45.35	20.75
Carmel	41	3.70	3.74	4.11	3.74	3.89	3.76	4.94	5.00	4.17	3.85	3.68	3.74	48.32	21.76
Catskill	6	2.60	3.41	3.26	2.41	4.26	2.83	4.42	3.33	3.93	2.28	3.26	3.30	39.29	18.77
Chatham	20	2.24	2.51	3.06	3.70	3.04	3.99	3.77	3.93	3.49	3.36	2.28	2.74	38.11	18.22
Greenwich	15	2.57	2.22	3.50	2.31	3.47	2.92	3.14	3.44	3.88	2.96	2.50	2.86	35.77	16.85
Hoosick Falls	18	2.34	2.32	2.91	2.72	3.04	3.73	4.37	3.73	3.36	3.10	2.57	2.30	36.49	18.23
Hudson	29	2.70	2.66	2.66	3.09	3.17	3.90	3.87	3.65	3.14	3.89	2.95	3.18	38.86	17.73
Kinderhook	17	2.21	1.53	2.48	2.97	3.41	4.49	4.36	3.23	2.84	3.26	2.69	2.76	36.23	18.33
Kingston	24	3.70	2.65	3.13	2.51	4.00	3.83	4.21	3.39	2.50	3.31	3.47	3.31	40.01	17.93
Middletown	18	3.13	4.02	4.12	3.17	4.03	4.06	5.40	4.61	4.19	3.74	3.24	3.48	46.83	22.29
Poughkeepsie	27	3.13	2.86	3.14	2.47	3.48	3.07	3.89	4.08	2.85	3.24	3.21	2.89	38.31	17.37
Red Hook	15	2.78	1.94	3.26	3.32	2.94	4.30	4.25	3.81	3.05	3.21	2.45	3.10	38.41	18.35
Troy	79	2.34	2.19	2.42	2.80	3.14	3.72	3.78	3.35	3.20	3.29	2.90	2.44	35.57	17.19
West Point	75	3.44	3.33	3.62	3.68	4.03	3.45	4.33	4.36	3.66	3.64	3.77	3.45	44.76	19.83
White Plains	26	5.50	4.68	4.18	4.01	3.41	3.50	4.99	4.58	3.57	3.87	4.28	4.88	51.45	20.05

*The climate of New York. By R. A. Mordoff. Cornell Univ. Agr. Exp. Sta. Bul. 444:75–80. 1934.

†May 1 to September 30.

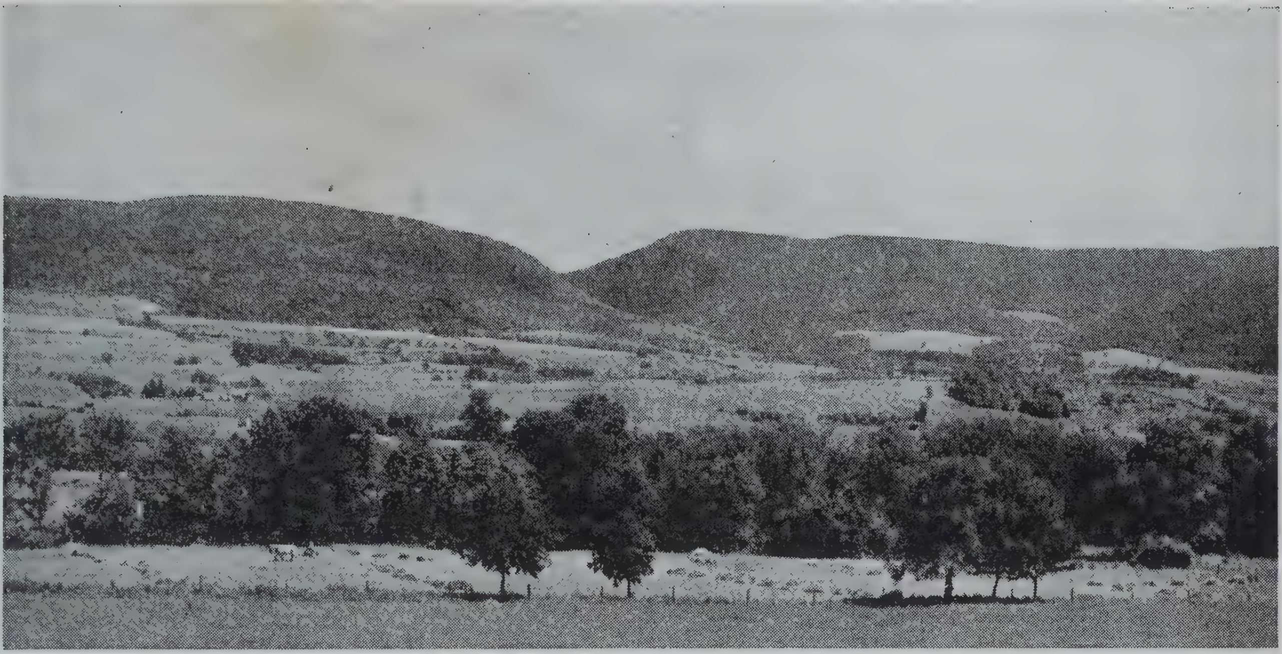

Figure 1. taconic mountains

The pasture and meadow in the foreground are on Bernardstown gravelly loam; the gently undulating land near the middle is Pittsfield soil. The notch in the skyline was cut by the creek which forms Copake Falls

or the old Hudson River terrace. In general, its topography is flat, with some V-shaped valleys cut into it by small streams and by the larger ones that carry drainage across the Hudson area from the foothill lands. Even more important agriculturally, is the outwash gravel deposited by the larger streams, particularly in the counties on the east side of the Hudson River. In the southern part of the area, the Hudson lowland

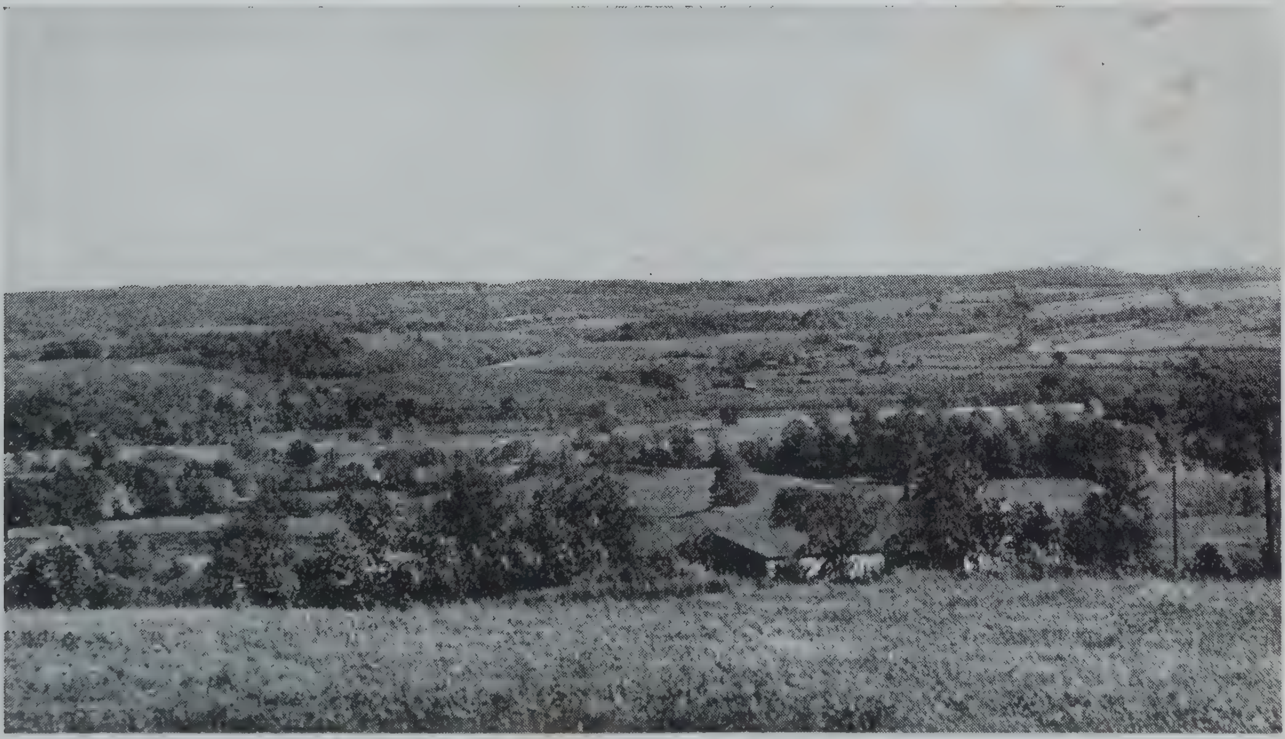

Figure 2. dutchess soils

Dutchess soils in the background with Cossayuna in the immediate foreground

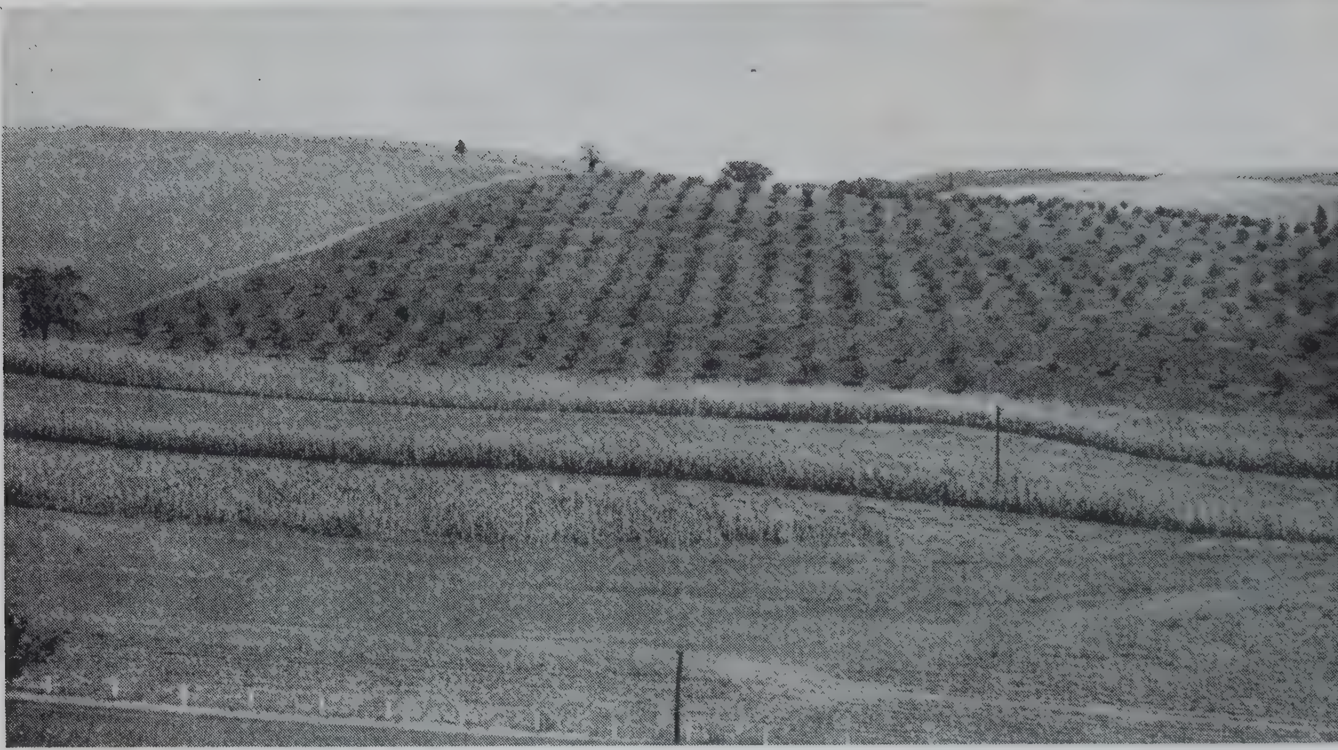

FIGURE 3. COS

This fine young orchard is located on a rather steeply sloping hill of Cossayuna
trees controls soil erosion and benefits the trees, and at the s

disappears completely and the foothill area borders the river (figure 2).

The flatter part of the Hudson lowland is lacking in surface drainage. In many places, however, the smaller streams have cut into the clay deposit, and afford a good opportunity for surface water to run off. The surface drainage of the hill section is, in general, good to excessive (figure 3).

The "hill section" is variable in topography, from the flat Hudson area to the mountains of more than 2000 feet in elevation. An extreme elevation of 2700 feet is reached at some points in the mountains. The area may be characterized as *rolling,* in the lower foothills, through *rugged to mountainous* in the higher areas. The agriculture of the upland proper is confined mainly to the rolling part of this section (figure 4).

TRANSPORTATION FACILITIES

Southeastern New York is well supplied with transportation facilities. Most important in the early days was the boat traffic on the Hudson River. More recently, the railroads have held first place in the movement of farm products to market and of supplies to the farm. At present, of equal, if not of greater, importance than rail traffic is that carried by trucks on the hard-surface roads. Of these, southeastern New York has a perfect network, including important trunk highways north and south on both sides of the Hudson River, and the important main roads east and west. Much farm produce is taken direct to market by truck over these roads. The Hudson River, however, is still functioning as an important means of transportation of bulky products.

VELLY LOAM

, with rows of trees planted near the contour. The alfalfa between the young
luces a fair yield of excellent hay. Dutchess soils in far background

MARKETS

Southeastern New York farms have at their very front door one of the best markets for farm products in America. The New York City area, with its population of 9,000,000; the Albany district, with 350,000; and Boston and other cities are a potential market for far more of agricultural products than this area can possibly produce.

General information that may prove helpful in connection with this bulletin is found in a number of publications of the Cornell Extension Service, of this Agricultural Experiment Station, and of the United States Department of Agriculture.

Soil maps have been made of the entire area except Greene County. Reports of Orange, Saratoga, Washington, and Dutchess Counties, and the White Plains Area (Westchester, Putnam, and Rockland Counties) are out of print but may usually be consulted at the local county agricultural agent's office and in libraries. Reports and soil maps of Columbia and Rensselaer Counties are available from Congressmen and county agents and from the Cornell University Agricultural Experiment Station. Ulster, Albany, and Schenectady Counties have been mapped, and Dutchess County was remapped recently. Reports and soil maps of these counties will become available later. The land-classification report for Rensselaer County is available (Experiment Station bulletin 675, by R. S. Beck, 1937). The following publications of the New York State College of Agriculture and of the Cornell University Agricultural Experiment Station contain valuable additional information:

Soils in relation to fruit growing in New York. Part VII. Tree behavior on important soil profiles in the Kinderhook, Germantown, and Red Hook areas in Columbia and Dutchess Counties. By L. P. Batjer and Joseph Oskamp. Exp. Sta. bul. 627. 1935.

Soils in relation to fruit growing in New York. Part XI. The organic-matter content of New York orchard soils in relation to orchard performance. By Ralph W. Cummings. Exp. Sta. bul. 672. 1937.

Liming New York soils. By A. F. Gustafson. Cornell ext. bul. 78. Reprinted 1940.

Meadow improvement through seeding, fertilization, and management. By A. F. Gustafson. Cornell ext. bul. 181. Reprinted 1937.

Drainage, plowing, and seedbed preparation. By A. F. Gustafson. Cornell ext. bul. 183. Reprinted 1938.

Pasture improvement and management. By D. B. Johnstone-Wallace. Cornell ext. bul. 393. 1938.

The control of soil erosion in New York. By A. F. Gustafson. Cornell ext. bul. 438. 1940.

Publications dealing with problems of fruit and vegetable production are available from the county agent and from the New York State College of Agriculture.

AGRICULTURE

The agriculture of southeastern New York, as shown in table 2, is predominately dairying, fruit-growing, poultry-raising, and vegetable production. Most of the forage for dairy cows, except near New York City, is produced in the area. A large share of the grain fed to cows and poultry, however, is shipped in from the Midwest.

The potato acreage has dropped materially during recent years but the combined acreage of sweet corn, tomatoes, and other vegetables is greater than the loss in acreage of potatoes.

Columbia County is fairly representative of the mid-Hudson fruit section (figures 5 and 6). In this county the number of apple and cherry trees more than doubled from 1900 to 1935; the number of peach trees is five times as great; pear trees more than three times; and grapevines

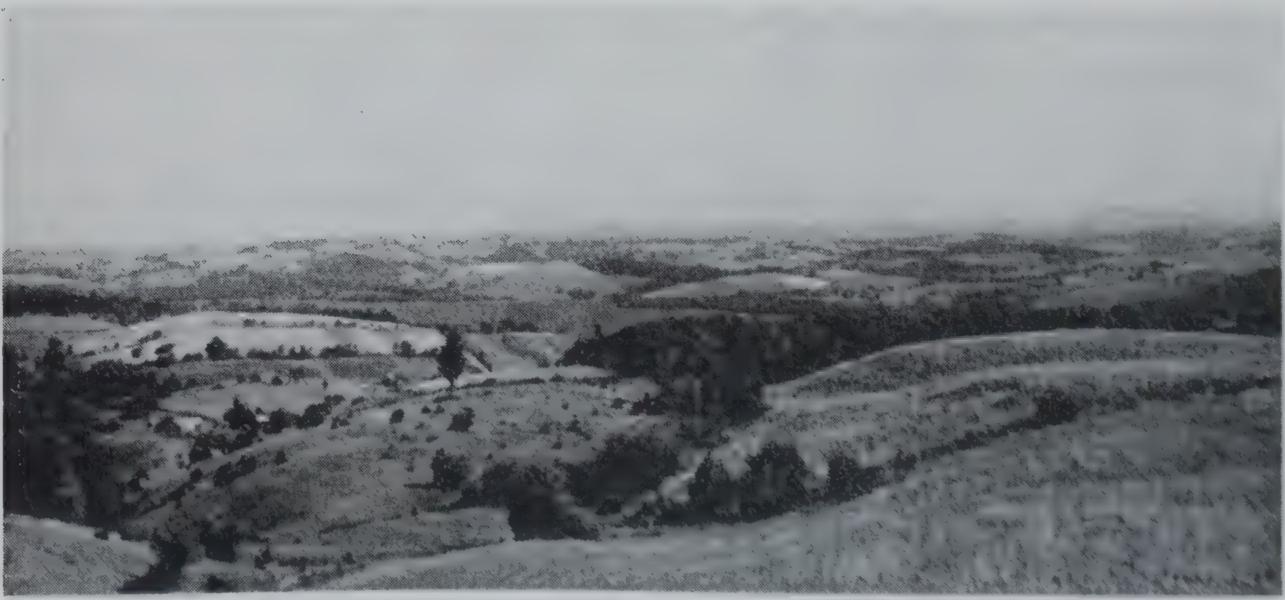

FIGURE 4. COSSAYUNA AND NASSAU SOILS WEST OF RAMERTOWN, RENSSELAER COUNTY

three times; but the number of plum trees decreased from 1900 to 1935. From the number of fruit trees not of bearing age in 1935, it appears that some of the trees that were winterkilled in February, 1934, have already been replaced by young trees (table 3).

TABLE 3. ACREAGE OF CROPS AND NUMBERS OF LIVESTOCK IN COUNTIES OF SOUTHEASTERN NEW YORK*

Items	Columbia	Dutchess	Orange	Rensselaer	Ulster	Washington
1. Hay, all kinds (acres)	64,560	77,858	99,864	74,276	54,672	110,723
2. Timothy, timothy and clover, and clover (acres)	48,989	46,426	49,874	56,251	39,260	99,164
3. Alfalfa (acres)	3,446	4,744	4,344	1,650	1,013	2,651
4. Pasture plowable and other (acres)	75,861	105,302	108,109	66,719	60,259	144,751
4. Pasture woodland (acres)	14,567	14,347	16,825	23,709	20,460	41,173
5. Small grains for hay (acres)	317	1,121	4,072	243	752	650
6. Annual legumes (acres)	46	178	44	10	77	110
7. Corn, field, all purposes (acres)	13,944	17,208	14,437	13,104	10,466	23,232
8. Wheat (acres)	450	1,068	694	227	1,540	194
9. Oats and mixed grain (acres)	8,665	9,923	3,351	2,444	4,830	17,464
10. Barley (acres)	62	29	......	38	65	355
11. Rye (acres)	2,452	585	218	1,535	380	915
12. Potatoes (acres)	1,394	1,491	1,867	4,439	1,334	5,529
13. Vegetables (acres)	717	1,033	7,056	2,694	3,488	363
14. Sweet corn (acres)	2,980	849	1,221	1,504	1,445	155
15. Tomatoes (acres)	229	208	304	182	1,078	22
16. Strawberries (acres)	258	155	104	165	310	64
17. Apples (trees)	655,622	431,273	257,583	112,245	555,503	71,487
18. Cherries (trees)	132,834	11,777	30,793	4,322	52,188	3,545
19. Peaches (trees)	63,099	46,432	144,690	10,127	128,561	434
20. Pears (trees)	232,735	39,911	41,866	19,292	129,018	1,396
21. Plums (trees)	10,686	4,526	3,699	2,527	11,929	2,872
22. Grapes (vines)	1,110,318	459,472	450,233	35,956	2,719,810	3,974
23. Horses and mules (number)	4,215	4,558	5,715	4,599	4,364	6,271
24. Cattle, total (number)	23,090	35,590	50,912	26,059	23,454	45,529
25. Cows (number)	15,079	21,159	39,044	18,164	15,733	33,054
26. Swine (number)	2,105	3,721	2,502	2,281	2,133	2,516
27. Sheep and goats (number)	7,327	3,594	1,052	7,775	1,935	12,484
28. Chickens (number)	160,970	217,071	383,183	209,064	452,307	174,773

*U. S. Census of Agr.: 1935, New York. Crop acreages for 1934; numbers of livestock, April 1, 1935.

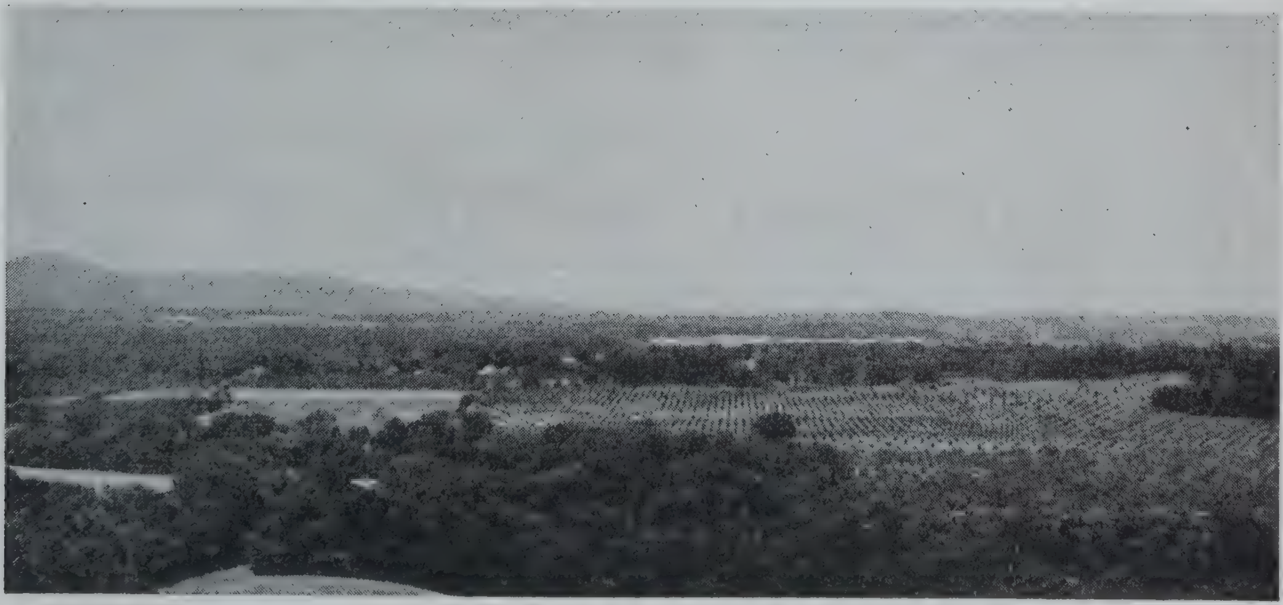

FIGURE 5. HOOSIC AND HUDSON SOILS

The apple orchard at the right is largely on Hoosic gravelly fine sandy loam. The flat area running the length of the view is the general Hudson lowland with its Hudson soils

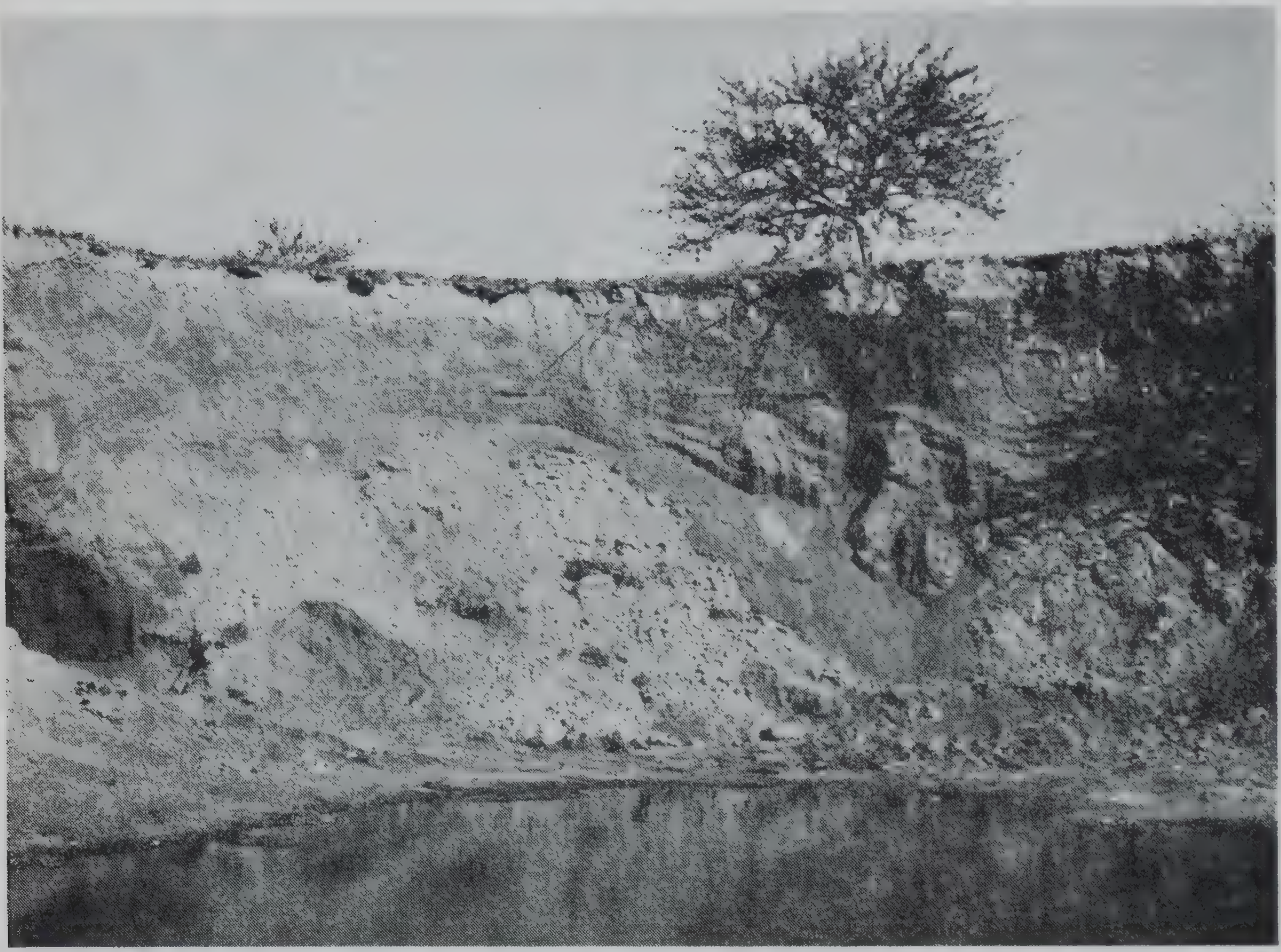

FIGURE 6. GRAVEL UNDER HOOSIC GRAVELLY LOAM

The separation into layers of different-sized gravel is clearly evident. The Hoosic soils owe their perfect underdrainage to this gravel substratum

A slight drop has occurred in the number of milk cows. The outstanding change in number of livestock has been the drop in the number of horses, swine, and sheep.

Orange County is representative of the agriculture on the west side of the Hudson River. A slight falling off has taken place in the acreage of hay. A notable increase has occurred, however, in the acreage of both clover and alfalfa. The acreage of potatoes has fallen off very markedly, but that of vegetables has increased; in fact, it doubled from 1924 to 1934. As representative of individual vegetables, both tomatoes and sweet corn have doubled during the 1924–34 period.

Fruit production in Orange County, as indicated by the number of trees, has changed greatly in recent years. The number of apple and cherry trees and of grapevines more than doubled during the 25 years from 1910 to 1935. During this period, the number of peach, pear, and plum trees, however, dropped below half of the number reported in 1910. The most severe drop is in the number of plum trees.

The livestock situation in Orange County is similar to that in Columbia, and is representative of that in the area, except that urbanization has proceeded more rapidly and much further in the more southerly part of this area.

The number of milking cows was nearly one-sixth less in 1935 than in 1910. The total production of milk, however, is being maintained.

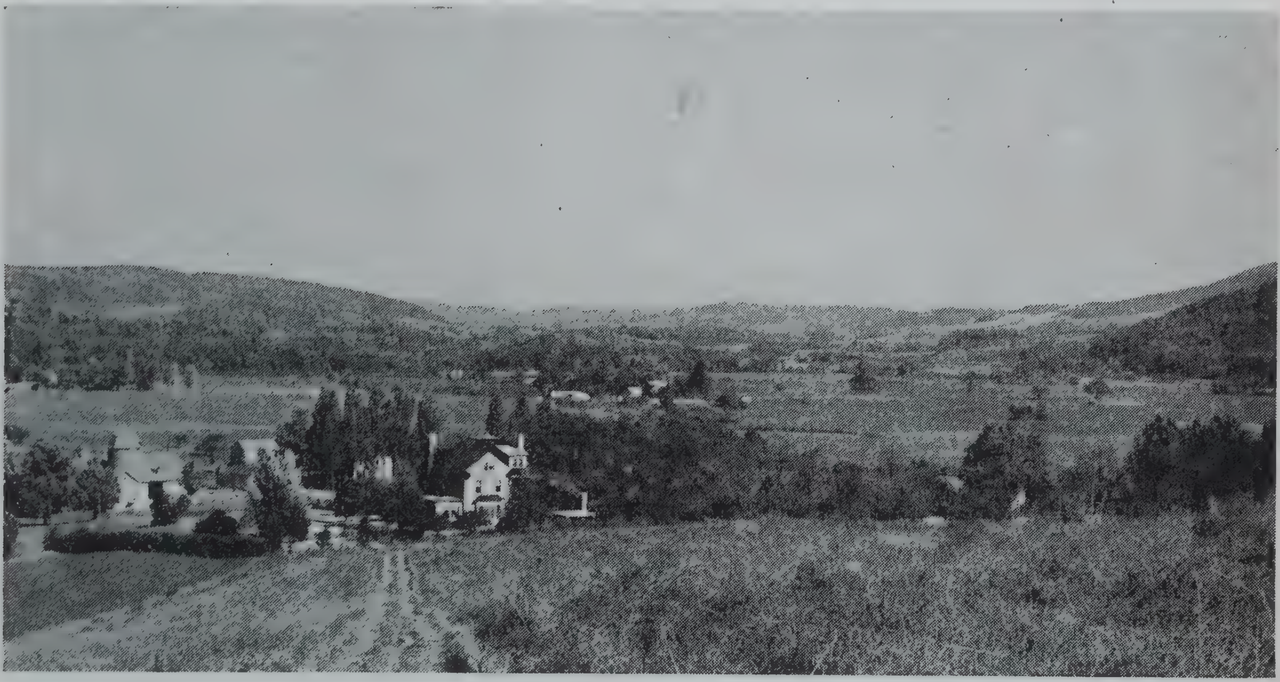

Figure 7. copake gravelly loam, in the valley

Corn stubble on Pittsfield stony loam in immediate foreground; alfalfa at left. Shelf in left background also Pittsfield stony loam. Rough stony land at extreme left and right in background

The number of horses, sheep, and swine has dropped rapidly, but the number of chickens has undergone a considerable increase during this period. As in Columbia County these shifts in the agriculture of Orange County are all favorable and dictated by price relationships of the products of these farms, and by the cost of the necessary supplies.

The changes are from the production of livestock feed to food for man. The best use of the more productive, more easily accessible agricultural soils is for the growing of crops for human consumption on an increasing proportion of the suitable acreage.

The less productive, less accessible, less easily tilled lands will be used for producing hay and pasture for dairy cows. The land still lower in the productivity scale and less accessible will be reforested with or without man's assistance.

An increase in the use of land for non-farm or rural residences is likely to take place on all soils and on all kinds of land in southeastern New York. The least accessible, if used, may well be taken up for summer homes and camps. Should any large share of the population have increasing leisure, a considerable acreage of land may be used to good advantage for recreation.

THE SOILS OF SOUTHEASTERN NEW YORK

Composition. All of the chemical elements needed for plant growth are probably present in all soils (figures 7, 8, and 9). Usually, however, one or two elements are present in such small quantities or in such unavailable form that crops are unable to obtain enough of them for satisfactory growth. The elements most commonly deficient are nitrogen and phosphorus, and sometimes potassium, sulfur, calcium, and magnesium.

FIGURE 8. ALFALFA ON PITTSFIELD STONY LOAM
This third growth of alfalfa is equivalent to more than a ton of hay to the acre

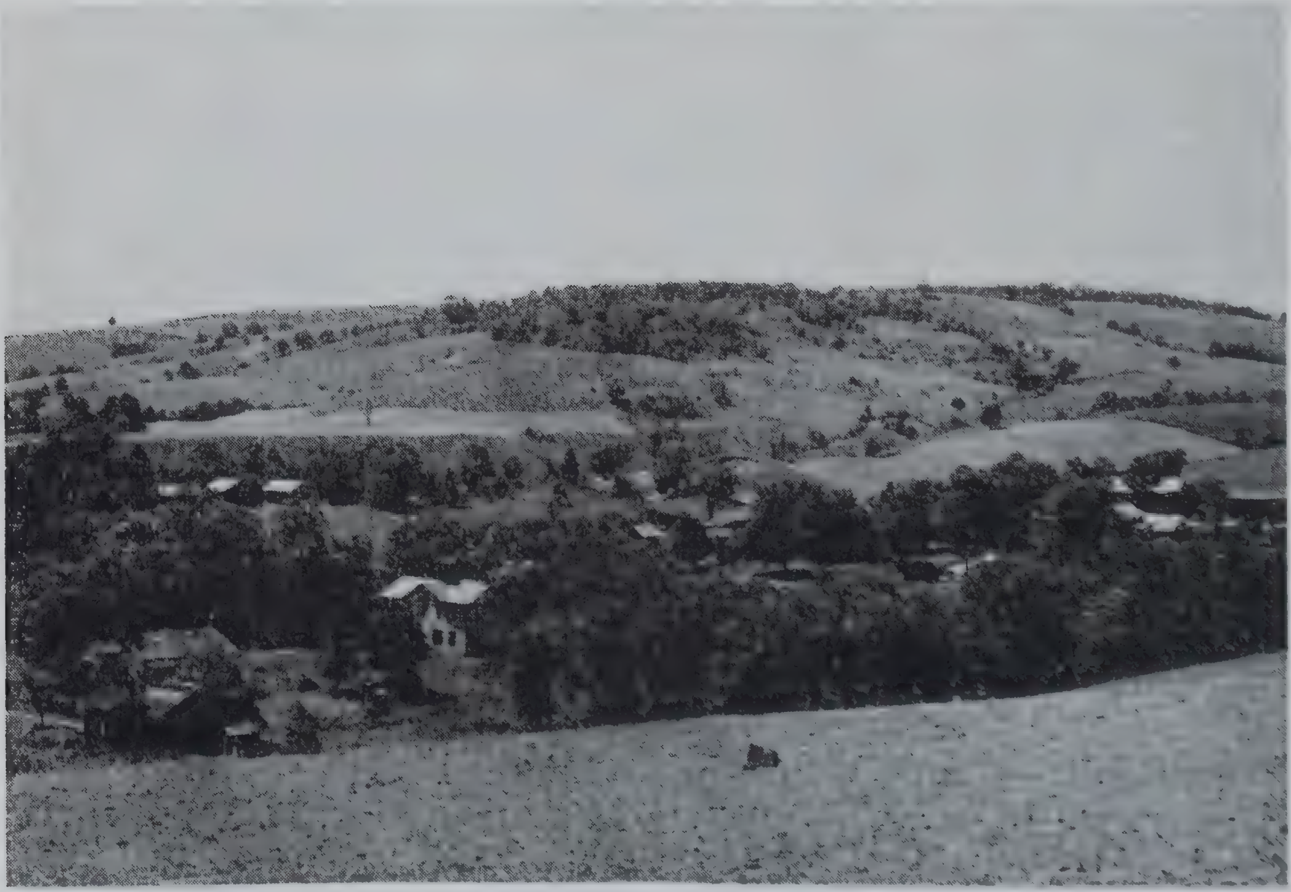

FIGURE 9. VIEW OVER GALLATINVILLE
Gravel pit in center, and to the left and right of it, Otisville gravelly loam. Dutchess in foreground and extreme background, with Bernardstown on lower slope beyond gravel pit

The surface 8 inches of loams, silt loams, and clay loams over an acre weighs about 2,500,000 pounds. The composition of soils collected in Columbia, Orange, and Dutchess Counties is given in table 4.

TABLE 4. COMPOSITION OF SOILS IN SOUTHEASTERN NEW YORK*

Soils and county where sample was taken	Depth of soil in inches	Plant-nutrient elements in the soil (pounds in 2,500,000 dry basis)					
		Nitrogen	Phosphorus	Potassium	Sulfur	Calcium	Magnesium
Cossayuna gravelly loam† Columbia (71)‡	0–8 8–24 24–36	5,100 1,975 2,275	1,325 1,175 1,225	45,500 49,000 73,500	925 800 1,750	5,750 3,250 1,750	17,000 18,500 26,750
Hudson silty clay loam§ Columbia (72)‡	0–8 8–24 24–36	5,125 2,900 2,350	1,675 1,125 1,425	60,000 84,250 87,750	1,525 925 825	3,250 3,500 30,750	21,500 32,500 39,000
Hudson silty clay loam§ Columbia (98)‡	0–8 8–24 24–36	6,050 2,650 2,425	1,125 825 1,100	61,000 82,000 82,500	1,250 475 475	9,000 3,500 5,500	23,500 30,250 34,750
Merrimac gravelly sandy loam Dutchess (63)‡	0–8 8–24 24–36	3,800 1,600 800	2,400 1,750 1,125	32,250 48,750 51,750	1,225 450 500	3,250 3,000 3,000	17,000 25,250 27,500
Pittsfield gravelly loam‖ Dutchess (25)‡	0–8 8–24 24–36	5,375 1,475 1,450	2,125 1,200 1,725	71,500 73,250 72,250	3,275 2,450 2,525	10,500 7,250 9,000	20,250 24,500 24,750
Gloucester stony loam Dutchess (28)‡	0–8 8–24 24–36	4,875 3,800 700	1,950 2,450 1,000	43,250 55,250 64,000	3,075 3,175 2,45[illegible]	21,500 18,750 17,500	32,500 29,750 49,250
Dutchess silt loam Orange (32)‡	0–8 8–24 24–36	5,375 1,925 1,375	1,375 700 825	26,750 33,250 38,750	2,600 2,175 1,425	4,500 4,500 6,500	11,000 13,500 14,500
Dutchess silt loam Dutchess (70)‡	0–8 8–24 24–36	4,200 1,825 1,575	1,475 1,175 1,125	39,000 50,750 59,500	675 375 450	6,000 4,250 9,000	16,500 20,750 24,250

*From *The Chemical Composition of New York Soils*, by J. A. Bizzell (Cornell Univ. Agr. Exp. Sta., Bul. 513. 1930).

†Formerly called Dutchess silt loam.

‡Designation number from bul. 513 of this Station.

§Formerly called Dunkirk.

‖Mapped as Dover loam in Dutchess County.

Because these are all virgin timber soils, the quantities of nitrogen and phosphorus in them are higher than may be expected in most field soils that have been cropped for a century or more, unless goodly applications of fertilizer and manure have been made.

With but one or two exceptions, the supply of phosphorus is low; and, without exception, applications of materials carrying this element may be expected to increase yields. Potassium appears to be present in abundance, but in some soils it may not be available to plants in sufficient quantities for good growth of some crops, particularly in the sandy and gravelly soils. Some samples, notably the second of the Dutchess silt loam, are unusually low in sulfur. This element may be supplied in manure and superphosphate or in sulfate of ammonia, or in mixed fertilizers containing these materials. All of the surface soils represented in table 4, except the Gloucester and Pittsfield soils, appear to be abnormally low in calcium, and in need of additions of it for best growth of crops, especially of legumes.

Characteristics and Crop Adapt

Soil series	Important or main type	Position	Topography	
				Soil
Adirondack	Stony sandy loam	Upland	Mountainous	Brown
Agawam	Loamy fine sand	Terraces	Flat to undulating	Brown
Albia	Gravelly loam	Upland	Rolling	Gray-brown
Allis	Shale loam	Upland	Rolling	Gray-brown
Alps	Gravelly silt loam	Upland	Rolling	Pinkish brown
Barbour	Silt loam	First bottom	Flat	Reddish brow
Basher	Silt loam	First bottom	Flat	Reddish brow
Bernardston	Gravelly loam	Upland	Rolling	Dark brown
Boynton	Gravelly silt loam	Upland	Flat to undulating	Dark brown
Charlton	Stony loam	Upland	Rolling	Brown-gray
Chenango	Gravelly loam	Terraces	Flat	Gray-brown
Claverack	Fine sandy loam	Terraces	Flat	Brown
Clyde	Loam	Upland	Flat	Black
Colonie	Fine sandy loam	Terraces	Flat	Light brown
Copake	Loam	Terraces	Flat	Brown
Cossayuna	Gravelly loam	Upland	Rolling	Dark grayish
Danby	Gravelly sandy loam	Upland	Hummocky	Gray
Dover	Loam	Upland	Undulating to rolling	Brown
Dutchess	Silt loam	Upland	Rolling	Gray-brown
Eel	Silt loam	First bottom	Flat	Dark
Essex	Stony loam	Upland	Rolling	Gray-brown
Farmington	Gravelly loam	Upland	Usually flat	Dark brown
Fox	Gravelly loam	Terraces	Flat to undulating	Brown
Genesee	Silt loam	First bottom	Flat	Dark brown
Ghent	Silty clay loam	Terraces	Flat	Dark brown
Gloucester	Loam	Upland	Rolling	Brown
Graywacke	Stony loam	Upland	Rolling	Dark gray
Groton	Gravelly loam	Upland	Hummocky	Gray
Hartford	Sandy loam	Terraces	Flat	Reddish brow
Hermon	Stony loam	Upland	Rolling	Gray
Hinckley	Sandy loam	Upland	Hummocky	Brown
Holly	Silt loam	First bottom	Flat	Gray
Holyoke	Stony loam	Upland	Rolling	Brown
Hoosic	Gravelly loam	Terraces	Flat	Brown
Hudson	Silty clay loam	Terraces	Flat	Gray-brown
Livingston	Silty clay loam	Terraces	Flat	Dark gray
Macomber	Slate loam	Upland	Rolling	Gray
Madalin	Silty clay loam	Terraces	Flat	Dark gray
Mansfield	Silty clay loam	Upland	Flat to depressions	Gray
Merrimac	Gravelly loam	Terraces	Flat to undulating	Brown
Middlebury	Silt loam	Terraces	Flat	Grayish brow
Nassau	Shale loam	Upland	Rolling	Gray
Ondawa	Silt loam	First bottom	Flat	Grayish brow
Orono	Silt loam	Terraces	Flat	Dark brown
Otisville	Gravelly sandy loam	Upland	Hummocky	Grayish brow
Peru	....	Upland	Flat to undulating	Black
Pittsfield	Stony loam	Upland	Undulating to rolling	Dark brown
Podunk	Silt loam	First bottom	Flat to undulating	Grayish brow
Poygan	Silty clay loam	Terraces	Flat	Dark brown
Rhinebeck	Loam	Terraces	Flat to undulating	Brown
Saco	Silt loam	First bottom	Flat	Dark
Scarboro	Loam	Terraces	Flat	Dark brown
Schodack	Gravelly fine sandy loam	Upland	Hummocky	Grayish brow
Schoharie	Silty clay loam	Upland	Undulating to flat	Light brown
Stockbridge	Loam	Upland	Rolling	Brown
Sutton	....	Upland	Flat	Brown
Tioga	Silt loam	First bottom	Flat	Brown
Troy	Gravelly loam	Upland	Rolling	Brown
Tunkhannock	Gravelly loam	Terraces	Flat	Reddish brow
Tyler	Silt loam	Terraces	Flat	Dark brown
Vergennes	Clay	Terraces	Flat	Dark gray
Walkill	Silt loam	First bottom	Flat	Dark brown
Wethersfield	Fine sandy loam	Upland	Rolling	Grayish brow
Whitman	Stony loam	Upland	Flat to depressions	Dark brown
Woodbridge	Stony loam	Upland	Rolling	Brown

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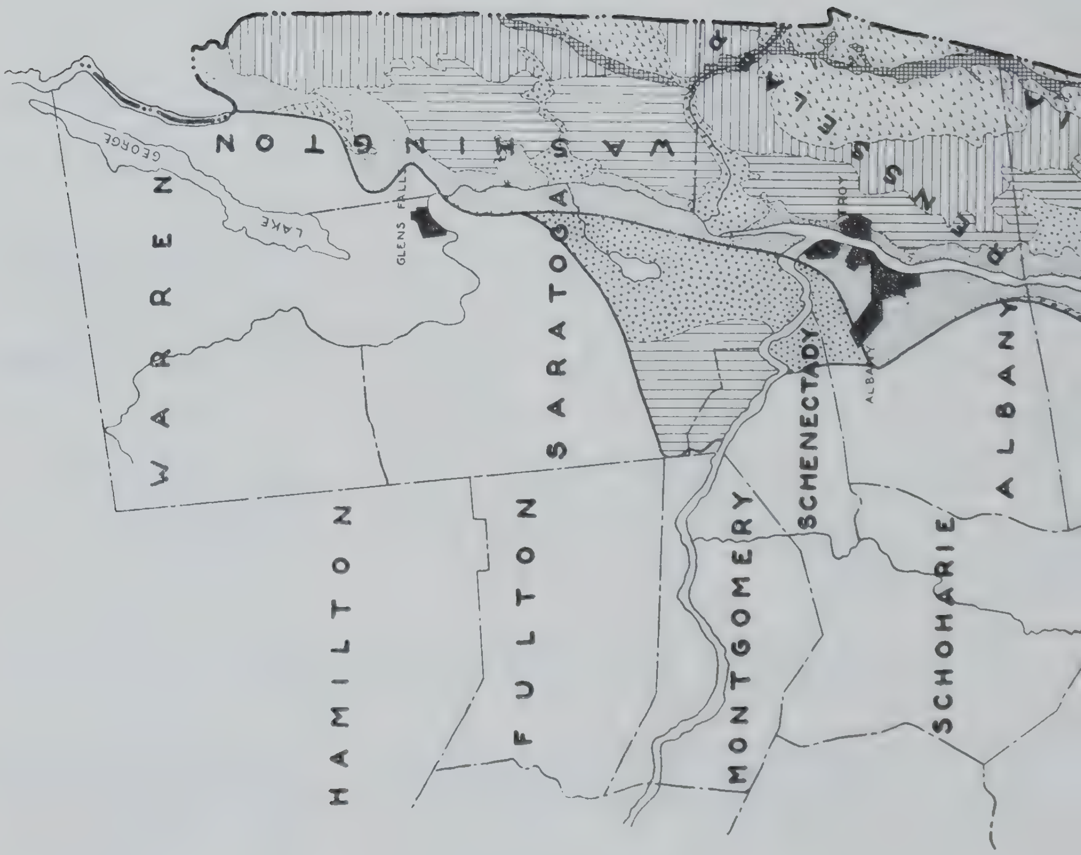
*Some soils not listed may be given in the forthcoming Dutchess County report.

†Adapted for fruits in the fruit zone.

Southeastern New York Soils*

Subsoil	Drainage	Reaction	Crop adaptations
ght brown	Good	Acid	Forest
ght brown	Well-drained	Acid	Hay, pasture, forest, corn, oats
ellowish	Imperfect	Calcareous (mildly)	Hay, pasture, corn, oats
uish gray	Poor—imperfect	Acid	Hay, pasture, forest
ownish	Imperfect	Calcareous (mildly)	Pasture, forest
own	Good	Acid	Corn, oats, hay, pasture
ay	Poorly drained	Acid	Hay, pasture
ellowish	Well-drained	Acid	Grass, and alsike for hay, oats, pasture
uish gray	Imperfect	Calcareous (mildly)	Corn, oats, hay, pasture, some cabbage
ay	Well-drained	Acid	Pasture, hay, feed crops
ellowish brown	Well-drained	Acid	Corn, oats, hay, alfalfa†
ayish	Fair	Calcareous (mildly)	Fruits, vegetables, feed crops†
ark gray	Poorly drained	Calcareous	Hay, pasture, corn, oats
ellowish brown	Well-drained	Acid	Pasture, fruits, corn, potatoes, wheat†
ght brown	Well-drained	Calcareous (mildly)	Alfalfa, corn, potatoes, oats†
ellow	Well-drained	Calcareous (mildly)	Fruit, vegetables, feed crops†
ellowish brown	Excessively drained	Acid	Alfalfa, clover, corn, oats†
eddish brown	Good	Calcareous	Alfalfa, clover, corn, oats, hay†
ght brown	Well-drained	Acid	Corn, oats, clover, potatoes, hay†
ayish brown	Imperfect	Calcareous	Pasture, some hay
ayish brown	Well-drained	Acid	Pasture, hay, feed crops
ght brown	Good	Calcareous	Alfalfa, hay, oats, pasture
ght brown	Well-drained	Calcareous	Same as Hoosic†
own	Good	Calcareous	Pasture, hay, feed crops
ottled gray	Poorly drained	Acid	Hay, pasture, corn, oats
ght brown	Well-drained	Acid	Hay, pasture, forest
ellowish	Well-drained	Calcareous	Pasture, forest
own	Well-drained	Calcareous	Alfalfa, clover, feed crops, fruit†
own	Good drainage	Acid	Alfalfa, clover, feed crops†
ght brown	Well-drained	Acid	Hay, pasture, corn, oats, potatoes, forest
ght brown	Well-drained	Acid	Alfalfa, clover, wheat, corn, oats, potatoes
ottled gray	Poorly drained	Acid	Pasture, some hay
ellowish brown	Well-drained	Acid	Corn, oats, hay, alfalfa
ght brown	Well-drained	Acid	Alfalfa, fruit, corn, potatoes, wheat†
ay	Imperfectly drained	Calcareous	Corn, oats, clover, pasture, some fruit†
ottled gray	Poorly drained	Calcareous	Pasture, hay, some corn, oats
ght brown	Well-drained	Acid	Corn, oats, hay, pasture
ottled gray	Imperfectly drained	Calcareous	Pasture, hay, corn, oats
ght gray	Poorly drained	Acid	Pasture, hay
ght brown	Well-drained	Acid	Alfalfa, clover, corn, oats
ottled gray	Imperfectly drained	Acid	Pasture, hay
ellowish	Well-drained	Acid	Corn, oats, alfalfa, hay, wheat
ayish	Fair to good	Acid	Pasture, hay
own	Well-drained	Calcareous (mildly)	Corn, oats, hay, pasture
own	Excessively drained	Acid	Alfalfa, clover, corn, oats, fruit†
ottled gray	Imperfectly drained	Acid	Hay, oats, corn, pasture
ive drab	Well-drained	Calcareous (mildly)	Alfalfa, clover, corn, oats, hay, fruit†
ayish	Imperfectly drained	Acid	Pasture, hay, corn, oats
eddish	Poorly drained	Calcareous	Pasture, hay
ottled brown	Imperfectly drained	Calcareous	Corn, oats, hay, pasture
ive gray	Poorly drained	Calcareous (mildly)	Pasture, hay, corn, oats
ottled gray	Poorly drained	Acid	Corn, oats, hay, pasture
ellowish	Excessive	Calcareous (mildly)	Alfalfa, clover, corn, oats, fruit†
nkish	Fair	Calcareous	Corn, oats, clover, hay
ellowish	Good	Calcareous	Corn, oats, hay, clover, alfalfa
ottled gray	Poorly drained	Acid	Hay, pasture, corn, oats
ght brown	Well-drained	Acid	Corn, oats, hay, pasture, clover
ellowish	Well-drained	Calcareous (mildly)	Corn, oats, hay, pasture, alfalfa†
own	Well-drained	Acid	Alfalfa, corn, oats, clover, wheat
. . . .	Poor	Calcareous	Pasture, hay
ayish	Imperfectly drained	Calcareous	Hay, pasture, clover, corn
ack	Poorly drained	Acid	Pasture, hay
eddish	Well-drained	Acid	Corn, oats, clover, alfalfa†
ay-brown	Poorly drained	Acid	Pasture, forest
ellowish brown	Well-drained	Acid	Pasture, hay, corn, oats


WARREN
LAKE GEORGE
WASHINGTON
GLENS FALLS
SARATOGA
TROY
ALBANY
SCHENECTADY
ALBANY
HAMILTON
FULTON
MONTGOMERY
SCHOHARIE

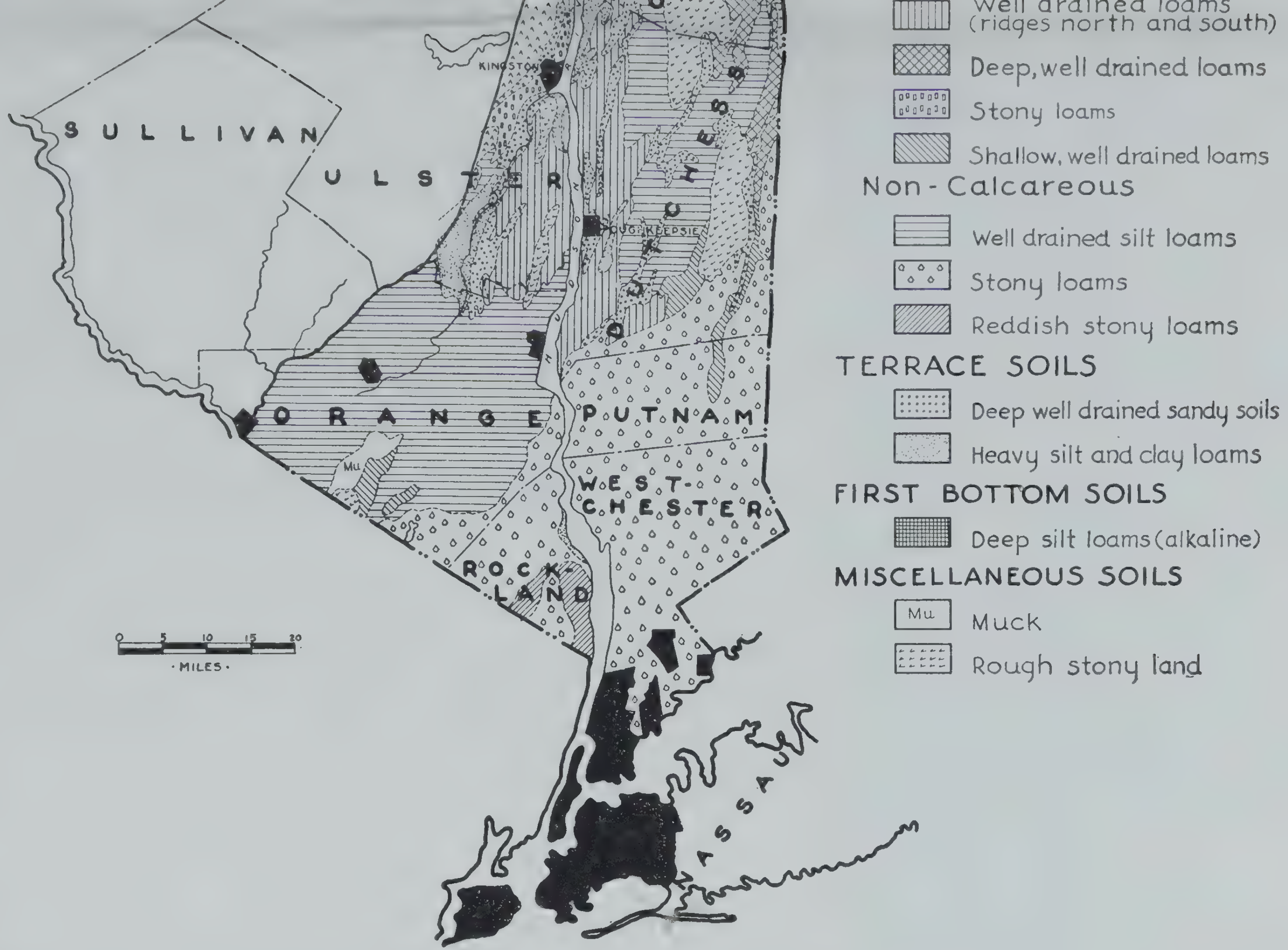


Figure 10. generalized soil map of southeastern new york

The characteristics and crop adaptations of the soils of southeastern New York are given in the tabulation on pages 14 and 15. Except for the final column, this was prepared by F. B. Howe, who is in charge of the state soil survey.

THE LIME NEEDS OF SOUTHEASTERN NEW YORK SOILS

The need of red clover for lime varies considerably for the different soil types in the area. According to table 4, some of the soils contain considerable lime while others are low in calcium and magnesium. When soil is low in lime it is undoubtedly rather acid, and consequently in need of liming for good growth of clover.

The study of the soils in preparation for the writing of this bulletin included the collection of many samples representing the important soils of this area. These soils were taken to the laboratory at Ithaca, dried,

TABLE 5. HYDROGEN-ION CONCENTRATION, pH, AND ESTIMATED LIME REQUIREMENT FOR RED CLOVER OF SOILS IN SOUTHEASTERN NEW YORK

Soil	Range in pH*		Range in lime requirement for red clover (tons per acre)§
	Surface†	Subsoil‡	
Albia gravelly loam	5.5	5.2	¾
Allis shale loam	4.9	4.3	1¼
Alps gravelly silt loam	4.8	4.9	1¼
Bernardstown gravelly loam	5.2–5.3	5.4–6.9	1
Boynton gravelly silt loam	5.1–5.2	4.7–5.7	1
Claverack fine sandy loam	5.8–6.0	5.4–5.8	¼–¾
Copake loam	5.0–5.8	5.0–6.6	½–1
Cossayuna gravelly loam	4.7–5.9	5.1–7.1	½–1
Culvers gravelly loam	4.8	6.3	1¼
Dover loam	5.0–7.8	5.1–8.5	None–1
Dutchess loam	4.9–5.6	5.1–6.0	¾–1¼
Genesee loam	5.5–6.4	5.9–6.6	¼–1
Ghent silty clay loam	6.5	7.2	None
Gloucester stony loam	5.0–5.4	5.4–5.8	¾–1
Gloucester fine sandy loam	4.7–4.8	4.8–5.0	1¼–1½
Groton gravelly loam	5.1–5.7	5.3–6.3	¾–1
Hermon stony loam	4.7–4.9	5.1–5.2	1 –1¼
Hinckley gravelly loam	5.1	5.6	1
Hoosic fine sandy loam and loam	4.7–6.1	5.1–7.4	½–1
Hoosic gravelly loam	5.0–6.0	5.3–6.0	¼–1
Hudson silt and clay loams	4.7–6.1	5.0–8.0	½–1
Livingston silty clay loam	5.6–6.4	7.5–8.4	None–½
Lyons silty clay loam	6.7	8.2	None
Mansfield silty clay loam	5.5–5.9	6.8–8.2	½–1
Merrimac gravelly loam	4.8–5.4	5.7	1 –1¼
Muck	5.8–6.2	5.1–5.2	....
Nassau shale loam	5.1–5.5	4.8	¾–1
Ondawa loam and silt loam	5.2–7.0	5.3–8.0	None–1
Orono silt loam	7.3	6.4	None
Otisville gravelly loam	5.1–7.3	4.9–7.7	½–1
Pittsfield loam‖	5.0–7.8	5.1–8.5	None–1
Podunk silt loam	6.9	6.8	None–1
Saco silty clay loam	5.7–6.5	6.3–6.6	None–1¼
Schodack gravelly loam	4.7–4.9	5.0–5.4	1
Stockbridge loam	5.0–7.5	5.1–8.3	None–¾
Troy gravelly loam	5.2	5.6	¾
Vergennes soils	5.2–5.5	5.6–8.4	1 –1½
Walton gravelly loam	4.9–5.5	4.8	¾–1¼
Weathersfield fine sandy loam	4.6–5.2	4.5–4.6	1¼
Woodbridge gravelly loam	4.7–5.3	5.1–5.3	1 –1¼

*Hydrogen-ion concentration, or pH, is the degree of acidity of the soil. A soil with a pH of 7.0 is neutral, while a pH figure of 7.5 is alkaline, and one of 5.5 is acid.

†Surface soil about 0–6 inches.

‡Subsoil, 18–24 inches.

§Expressed as tons of high-grade finely ground limestone to the acre. Lime requirement is estimated by means of the potassium thiocyanate test by comparing with "standard" soils whose lime requirement is known.

‖Mapped Dover in Dutchess and Washington Counties and in the White Plains Area.

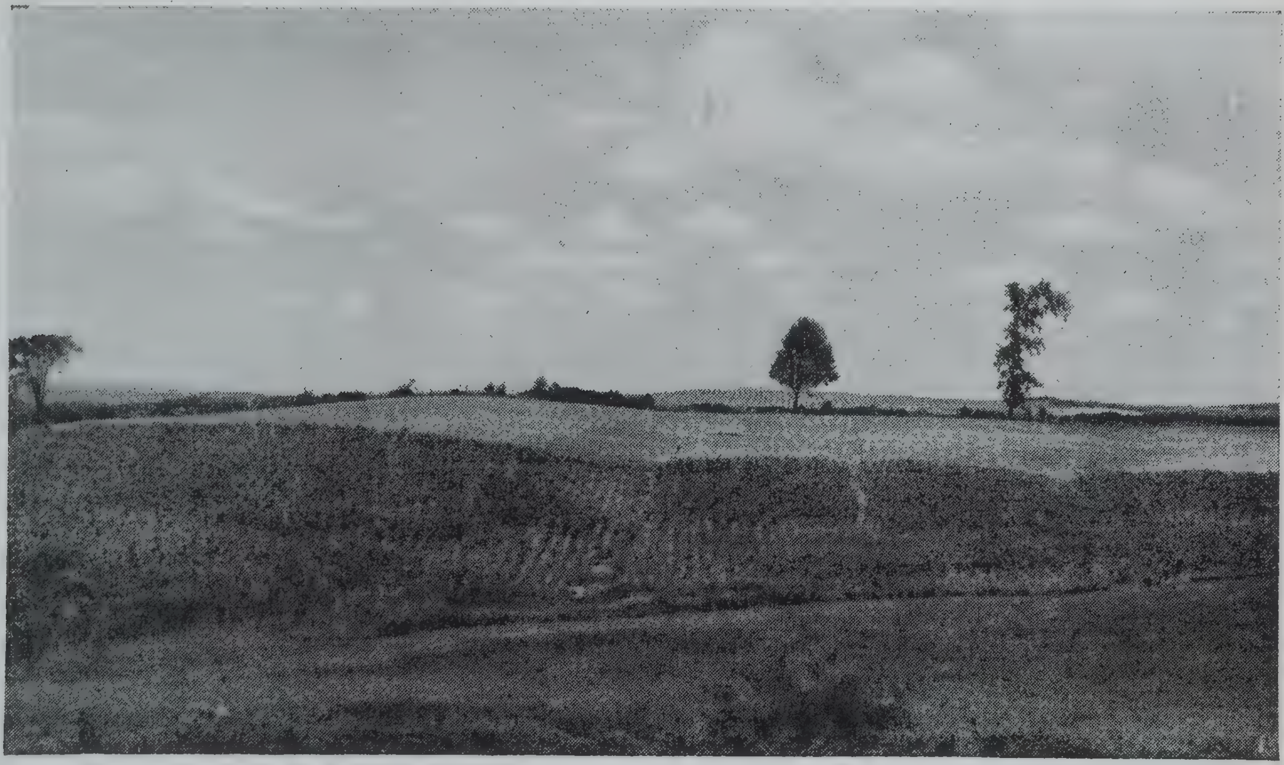


Figure 11. erosion caused by concentration of water on slope above planted to potatoes (rensselaer county)

Water collected by the potato rows down the moderate slope caused the gullies across the corn. The small growth of the corn near the gullies indicates that the surface soil has been washed away

prepared, and tested for hydrogen-ion concentration and for lime requirement for clover. The data on pH given in table 5 may be useful to growers of cabbage, potatoes, and other vegetables.

In this table are shown variations in lime requirement and pH within a soil type, but usually there is fairly good uniformity. Some variation may be explained by differences in treatment of the soil because these samples were collected from actively-farmed fields in so far as possible. Lime requirements of less than one-half ton are given to complete the picture of relationship between pH and lime requirement, but it is not intended to recommend that less than one-half ton be applied for clover. Where less than one-half ton is required, the deficiency may be taken care of by somewhat heavier than usual use of superphosphate and by top-dressing the new seeding with manure.

In table 5 is given the approximate lime requirement for clover on certain soil types; however, ordinary variations in soils should not be overlooked. The soils of different fields should be sampled and tested for lime requirement for red clover. Sampling to determine the adaptability of a soil for alfalfa and testing the samples for lime requirement for this crop are essential.[1]

SOIL EROSION IN SOUTHEASTERN NEW YORK

The surface soil is the first to be lost by washing, or erosion.[2] Since this soil layer is the richest in organic matter and plant nutrients, its

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[1] The county agricultural agent has equipment for sampling soils and for estimating their lime requirement for alfalfa and clover. He will advise as to the kind and quantity of lime to be used, if any is needed.

[2] Additional information on the subject is given in *The Control of Soil Erosion in New York* by A. F. Gustafson (Cornell ext. bul. 438, 1940).

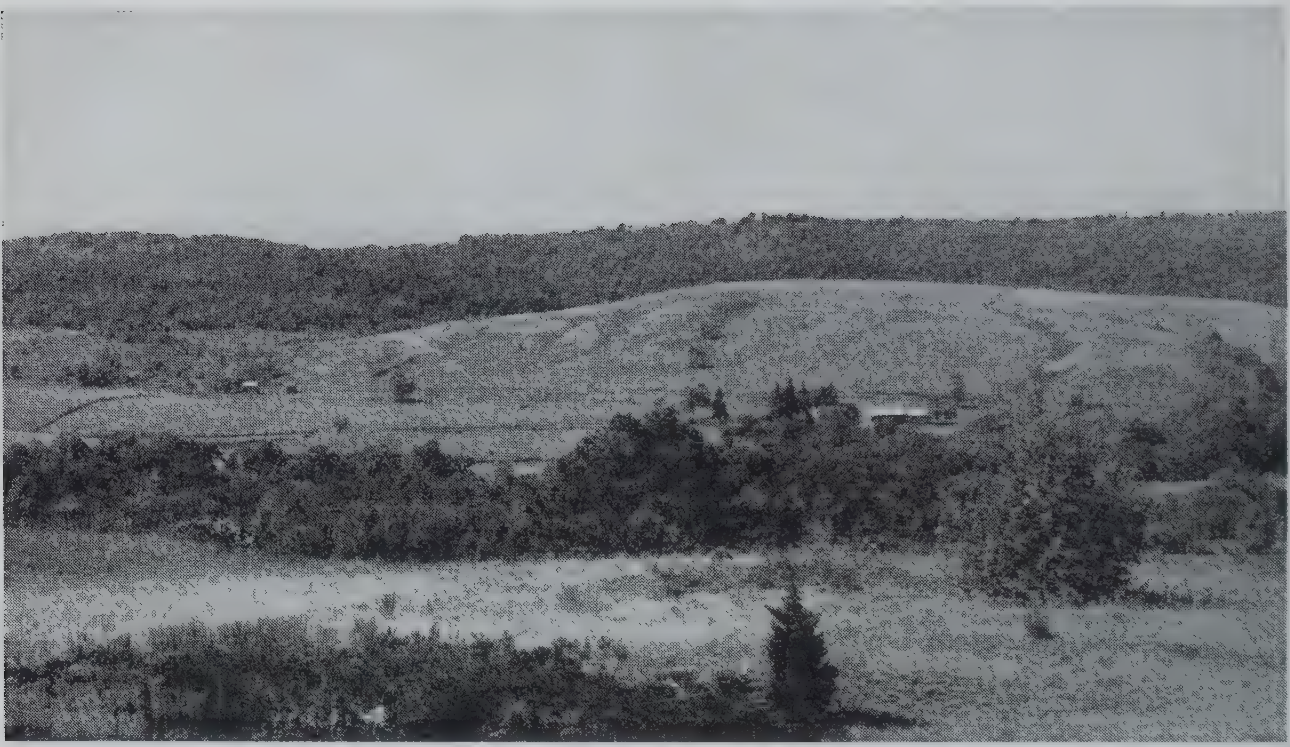

FIGURE 12. EROSION ON BERNARDSTOWN GRAVELLY LOAM

The hill in the center, which is immediately south of West Taghkanic, was badly gulleyed, and cropping was abandoned some years ago. The gulleys have become sodded so that erosion is no longer active. Slopes as steep as this should be kept permanently in grass

loss is bound to materially reduce crop yields. In fact, the sloping soils of this area have suffered greater permanent injury from soil erosion than from any other cause, either natural or induced by man (figures 11, 12, and 13).

Erosion may be expected to occur on moderate to steep slopes in the hill section and on all slopes of the Hudson soil types and on slopes of such strictly upland soils on the general Hudson lowland as the Cossayuna and Pittsfield. Erosion occurs on steep slopes of the Otisville and Groton soils. Damage from erosion is seldom serious on the gravelly soils such as the Hoosic, Claverack, Copake, and Merrimac, or on the nearly level phases of the Hudson soils.

Methods recommended for controlling soil erosion in southeastern New York. For all of the steeply sloping upland soils and for the slopes of the Hudson soils, nature's own forest growth is the best agent for the control of erosion. Next best is a good thick pasture sward or a thick stand of meadow grasses or small grains. Pasture may be employed to real advantage on rather steep slopes, and meadow on slopes that are not too steep for the carrying on of the regular operations of hay making.

On land that is being cultivated, the following suggestions and recommendations may be helpful:

1. Plow, plant, and cultivate intertilled crops across or around rather than up and down the slope, in so far as feasible.
2. Drill grains and meadow seedings around or across the slope.
3. Keep up the organic-matter content of the soil by growing clover, and by returning organic matter in the form of manure as generally as possible, and green manures wherever feasible.

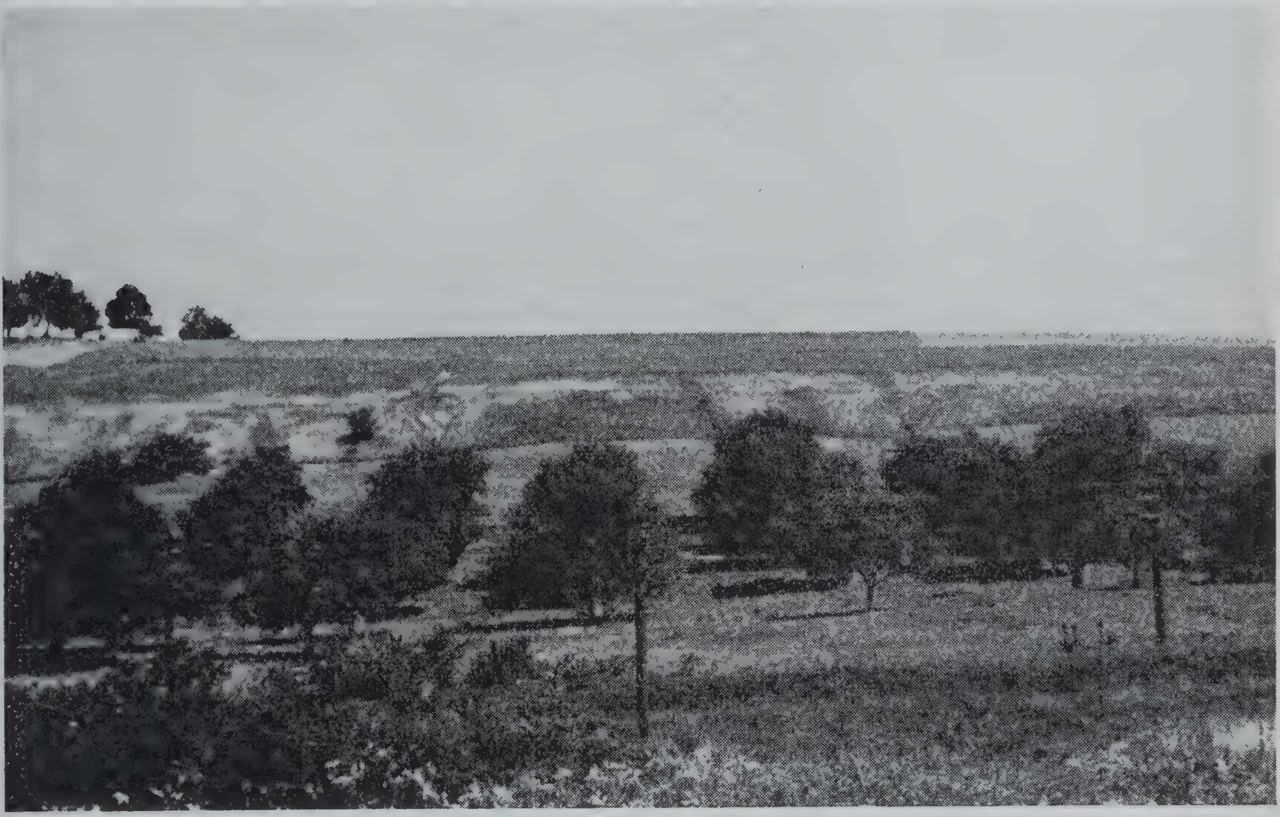

Figure 13. erosion near chatham, columbia county

4. Use lime if needed for clover and superphosphate as suggested in the section on rotations (page 24). These are very helpful in producing large root systems, good soil cover, and good yields. Large, fibrous root systems hold the soil together and thus aid in controlling erosion.
5. Keep all moderate to steep slopes under the protection of vegetation, such as hay or pasture grasses and forest.

PRODUCTION OF FARM MANURE

Owing to the variation in the agriculture of the different sections of this area, the quantity of manure produced to the farm is highly variable. Farms range in size from an average of 33 acres in the fruit section, to 225 acres in dairy-farming areas. Since few animals are kept on the fruit farms, little manure is produced on these. On the other hand, in a dairy section with large farms and good-sized dairy herds the annual production of manure is 200 tons on many farms, and exceeds this quantity on the larger farms. In general, the farms are small in the fruit belt and in the hill sections. Dairying is carried on generally in the hill section; consequently farms in that area are the ones moderately well supplied with manure. On the fruit-belt farms, on the other hand, far more manure could be used to advantage than is produced there.

Unfortunately the full value of manure is not always recognized by farmers. An average ton of farm manure contains 10 pounds each of nitrogen and potash, and 5 of phosphoric acid. A farm that produces 200 tons of manure a year, therefore, has a little fertilizer factory all its own, since that quantity of manure contains 2000 pounds of nitrogen, 1000 of phosphoric acid, and 2000 pounds of potash. These quantities of total nitrogen and potash are equivalent to those in 20 tons of a 5–10–5 fertilizer,[3] and that of phosphoric acid to that in 2½ tons of 20-per-cent superphosphate. It should be considered, however, that the plant nutrients in manure are, as a whole, less readily available than are those in commercial fertilizer; yet much of the nitrogen and a considerable part of the phosphorus and potash in manure becomes available during the growing season for which it is applied.

In applying manure at the rate of 10 loads to the acre, 100 pounds each of nitrogen and potash and 50 pounds of phosphoric acid go onto each acre. This quantity of nitrogen and potash is equivalent to that in 2000 pounds of a 5–10–5 fertilizer, and the quantity of phosphoric acid is equal to that in 250 pounds of 20-per-cent superphosphate. Therefore, a 20-ton application of manure, which is not unusual, is a heavy application of nitrogen and potash.

These rates of application of plant nutrients in commercial fertilizers are, of course, far higher than farmers normally make for feed crops, but too often the results from such applications are compared with those from the use of about 200 pounds to an acre of a factory-mixed fertilizer or of superphosphate. These figures explain the reason for the apparent greater effectiveness of manure than of fertilizers in producing crops.

Both nitrogen and potash may easily be lost from manure. Experimental work shows least loss of nutrients and largest increases in yield from the use of manure when it is hauled to the field and spread daily.

Losses in value of manure in storage are very great. At Ithaca, horse manure placed in an open pile in late April and weighed and analyzed again early in October had lost 57 per cent of its organic matter, 60 per cent of its nitrogen, 47 per cent of its phosphorus, and 76 per cent of its potash. For cow manure the loss was 49 per cent of its organic matter, 41 per cent of its nitrogen, 19 per cent of its phosphorus, and 8 per cent of its potash. Similar losses may be expected when manure is stored over summer in a loose pile.

Because these severe losses may be expected, it seems wise to store manure under cover whenever possible, or in a deep flat-topped pile with a slight slope toward the center. When this is done the rain falling on the pile is taken up by the manure, and this keeps it moist and reduces the extent of rotting. Since the pile is from 4 to 6 feet deep or more the water falling on it is retained and leaching is avoided. It is usually best, however, to haul out fresh manure and spread it daily. Losses are lowest when manure is used in this way.

Recommended usage of manure. The crop increases produced by manure depend on the rate of application, or the number of tons used to the acre. It has been shown clearly that moderate applications, such as 8 or 10 loads to the acre, give much larger returns from the manure used than do heavier applications, such as 20 to 30 loads to the acre. Obviously twice as many acres can be given 10 loads from a given quantity of manure as can receive 20 loads to the acre. Or one can manure the whole farm twice as often with the lower, as with the higher rate of application. If 10 loads can be put on once in four years it will be eight years between 20-load applications. The lighter, more frequent applications of manure are the more desirable and more profitable.

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[3] A 5–10–5 fertilizer is one that carries 5 per cent of nitrogen, or 5 pounds in a hundred, or 100 pounds of nitrogen in a ton. It carries the same quantities of water-soluble potash and 10 per cent, or 200 pounds, of available phosphoric acid in a ton of fertilizer.

As already indicated, manure is relatively low in phosphorus. For feed crops, manure should be supplemented with phosphorus. The most economical way to do this is by adding for each cow 1 to 2 pounds a day of inexpensive 20-per-cent superphosphate or its equivalent in other analyses[4] to the manure in the barn. This is from 300 to 600 pounds of superphosphate to the acre if 10 tons of manure is used. It is then spread with the manure, thus avoiding the labor cost of applying the superphosphate separately.

Another, but less satisfactory, way is to put superphosphate on the load of manure just before it goes to the field. Or the superphosphate may be drilled onto manured land at seeding time.

FERTILIZER EXPERIMENTS

The experiments made with soil types in this area included Dutchess silt loam from Dutchess and Orange Counties.[5] Applications of nitrogen, phosphorus, and potash gave a goodly increase in yield of feed crops. Complete fertilization and liming produced an average yield of feed crops on these two Dutchess soils that was more than four times the yield of the untreated soils. Liming alone nearly trebled the yield. Phosphorus alone increased yields by one-fifth; potash used alone increased yields by one-third; and nitrogen increased the yields of feed crops by one-half on these two Dutchess soils.

On the Vergennes soil phosphorus raised the yield one-fifth; potash had no effect; but nitrogen increased the yield of feed crops nearly one-half.

On the Dutchess soils feed crops may pay for the nitrogen used, near New York City, on hay because it is a bulky product on which carrying charges are relatively heavy. On the Vergennes soils, however, in Washington and Saratoga Counties, one cannot expect the use of commercial nitrogen to prove profitable on hay crops under average prices for hay and dairy products. In this area on Vergennes soils farm manure and legumes must be depended on mainly to supply feed crops with the needed nitrogen.[6]

Phosphorus, as indicated in table 4, page 13, is rather deficient in many of the important soils of southeastern New York. Some soils are particularly deficient in phosphorus in the subsurface and the upper subsoil. Manure furnishes minor quantities of phosphorus, but the only other way to add it to the soil is to buy it, usually as superphosphate or mixed fertilizer. Many indications of lack of phosphorus available to crops may be noted throughout the area from the appearance and growth of plants.

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[4] The 20-per-cent superphosphate is meant when the percentage is not specified. Higher-analysis superphosphates which are on the market are perfectly satisfactory. Five hundred pounds of 16-per-cent, 400 pounds of 20-per-cent, 250 pounds of 32-per-cent, and 200 pounds of 40-per-cent superphosphates all supply exactly the same quantity of actual phosphorus.

[5] *Fertilizer tests for several soil types*, by T. L. Lyon, Cornell Univ. Agr. Exp. Sta., Bul. 520, 1931.

[6] Further information is given in *Legumes as a Source of Available Nitrogen in Crop Rotations*, by T. L. Lyon (Cornell Univ. Agr. Exp. Sta., Bul. 500, 1930).

Potash, as may be seen in table 4, is present in relative abundance on most of these soils. However, it is not always so readily available as might be desired. Manure supplies considerable potash, and in turn aids in making potash from the soil available to plants.

FERTILIZER RECOMMENDATIONS

For feed crops on many dairy farms the principal fertilizer element that must be purchased is phosphorus, usually in the form of superphosphate. Clover, alfalfa, or other legumes should be grown freely in the rotation for producing high-protein roughage and for supplying nitrogen to grass and grain crops. It usually pays to inoculate the legumes. In special cases a mixed fertilizer high in phosphorus, such as a 4–16–4 or 5–20–5 might be justified.

For potatoes, sweet corn, and other vegetable crops, a complete fertilizer usually gives best results.[7] Fertilizer recommendations for these crops are given in Cornell extention bulletin 281.

While many different mixed fertilizers are used in the area, superphosphate and three mixed fertilizers will satisfy the important fertilizer needs of the crops grown in the area, with the exception of fruit.

These fertilizers are the 5–20–5 and 10–20–10 or other mixtures carrying the same ratios of plant nutrients. For example the 5–10–5, 8–16–8, and 10–20–10 all have the same ratio, or 1–2–1; that is, these mixtures carry twice as much of phosphoric acid as of nitrogen and potash. Reducing the number of analyses of fertilizer on the market will save money for both the fertilizer manufacturer and the farmer.

ROTATION OF CROPS

The value of manure, lime, fertilizers, and good tillage[8] has been recognized by farmers for many years, but the benefits that may be derived from following a rather regular rotation of crops suited to the climate, to the soil, and to the prevailing type of farming are not fully understood nor fully appreciated. Growing crops including a legume in a regular order helps to keep up, or to increase, crop yields. It should be emphasized that the increased yields resulting from properly rotating crops are obtained in addition to increases resulting from the use of manure, fertilizer, and lime, and from suitable tillage. A crop following a legume is benefited by the nitrogen fixed by it and left in the soil when the legume is plowed under. Furthermore, growing crops in fairly regular order and plowing at regular intervals help in keeping weeds under control, particularly those that thrive in meadows.

RECOMMENDED ROTATIONS AND FERTILIZATION FOR GRAIN AND FORAGE CROPS

Rotation 1. *For Dutchess, Cossayuna, Pittsfield, Bernardstown, Stockbridge, and minor soils in the hill area*

First year. Corn: 10 loads of manure supplemented with superphosphate in the stable, as already suggested, or from 50 to 60 pounds of 20-

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[7] Valuable detailed information on fertilizers is given in *Fertilizer Recommendations for New York* (Cornell ext. bul. 281, 1929).

[8] Helpful information along this line is given in *Drainage, Plowing, Seedbed Preparation, and Cultivation in New York,* by A. F. Gustafson, Cornell ext. bul. 183, 1938.

per-cent superphosphate to the load as the manure goes to the field. This treatment is sufficient for a 4-year rotation of feed crops. As the quantity of manure to the acre is varied, a corresponding change should be made in the quantity of superphosphate used to the load. At least 150 pounds of 20-per-cent superphosphate should be used to the acre a year as a minimum average over the period of the rotation. Since these soils are very low in native phosphorus, it is especially important that phosphorus be used regularly.

If it is more convenient to use about 300 pounds of 20-per-cent superphosphate at seeding time for corn and the same quantity for oats, that method of fertilizing the rotation also is satisfactory.

Second year. Oats: a mixture of oats and barley may be preferred on the higher elevations.

No treatment except liming as needed for clover, if full superphosphate treatment was used for corn. If only 300 pounds was used for corn, a similar quantity is needed for oats.

Third year. Clover[9] and timothy:[10] no treatment unless sufficient manure is available to permit of an application of about 8 loads to the acre.

Fourth year. Timothy and other grasses and clover: ordinarily no treatment is needed, since timothy usually makes a good yield the first year after clover.

A long-lived or a perennial legume is needed in most meadow mixtures. Alfalfa serves this need on the well-drained soils that are sufficiently supplied with lime or on which an abundance of lime has been applied. The successes that have been reported in southeastern New York from seeding ladino clover with grasses on productive soils that have sufficient lime, prompt the suggestion that ladino clover might be tried out in a modest way. In places, ladino has given a good yield for one or even two years after red clover has gone out. The seed of ladino clover is high in price, but small in size, so that a small quantity of seed goes a long way.

On lands not so favorably located or less easily tilled owing to stones, rock ledges, or lack of good drainage, it is feasible to leave the land in grass for some additional years. When this is planned for, two things are essential: the application of 20-per-cent superphosphate up to the average of 150 pounds an acre a year, and frequent light applications of manure if legumes are not growing well. Eight loads to the acre, with 50 or 60 pounds of 20-per-cent superphosphate to the load, put on every three years helps greatly in keeping timothy clean and productive. Since the manure spreader tears up the manure as it spreads it, the use of this implement gives best results in manuring meadows. This fertilizer treatment is inexpensive when returns are considered, and it improves the mineral balance of the resulting hay for feeding purposes.

If the roots should be heaved badly it is better to plow up and reseed; otherwise the yield will be seriously reduced.

On all of the well-drained soils, alfalfa may well be sown in the meadow mixture at a rate of at least 5 pounds to the acre, in addition to red clover. It is not likely to pay to seed any alfalfa on poorly drained soils or those underlain with hardpan or shale near the surface.

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[9] For further information see *Seventy-six Clover Questions Answered,* by H. B. Hartwig, Cornell ext. bul. 210, 1931. Also, *The Effect of Some Legumes on the Yields of Succeeding Crops,* by T. L. Lyon, Cornell Univ. Agr. Exp. Sta., Bul. 447, 1925.

[10] Helpful details are given in *Meadow Improvement Through Seeding, Fertilization, and Management of Meadows,* by A. F. Gustafson, Cornell ext. bul. 181, revised 1937.

Sometimes it may be desired to cut timothy beyond the fourth year of the rotation. If the grass contains little or no alfalfa or other legumes and if manure is not available, commercial nitrogen may be used to advantage on some farms. This is more often true near cities or where hay is purchased regularly. Good thick stands of grass can be kept productive by applying nitrogen or a complete fertilizer if insufficient phosphorus was put on for the rotation before seeding the meadow mixture. An application of 200 pounds of nitrate of soda or 150 pounds of sulfate of ammonia or 100 pounds of uramon should prove exceedingly helpful for the meadow grasses. Similar, or even somewhat larger, quantities of nitrogen may be applied in other carriers of this element.

Millet or sudan grass may be used in rotation 1 in place of corn. These crops seldom yield as much feed as corn does on good soils but they serve well as green feed or for hay. Under favorable soil conditions these annual hay crops thrive when fertilized as suggested for corn.

Rotation 2. *For areas where it is not desired to grow corn*

First year. Oats: lime as needed for clover and 400 to 500 pounds of 20-per-cent superphosphate to the acre.
Second year. Clover and timothy: no treatment.
Third year. Timothy and clover: no treatment.
Fourth year. Timothy: 8 loads of superphosphated manure to the acre, with 60 pounds of 20-per-cent superphosphate to the load. Repeat the manure-superphosphate treatment every three years, or every two, if the supply of manure is sufficient. The quantity of superphosphate to the load is adjusted so as to apply not less than an annual average of 150 pounds a year to the acre for the rotation.

On the Hudson lowland, fruit and vegetables should have first consideration in the section and on the soil types adapted to them, such as the Hoosic, Cossayuna, and associated Pittsfield and Claverack, and to a small degree the Hudson fine sandy loam. On well-drained soils in the fruit belt not occupied by fruit or vegetables, alfalfa should have first consideration. If there is sufficient acreage for a rotation, a good one is: first year, corn, second year, oats, and alfalfa following the oats, to continue as long as it cuts good crops or until the land is needed for corn. Corn and oats may be treated as suggested for them in rotation 1. Not less than an average of 150 pounds of 20-per-cent superphosphate an acre a year should be used for alfalfa, since it feeds heavily on phosphorus.

The heavy Hudson types are better adapted for the production of hay and pasture grasses than for corn or small grain. Rotation 2 may be suitable under many conditions. Special attention should be given to the question of heaving of timothy. A good aftermath cover helps in reducing alternate freezing and thawing and consequent heaving. If this can be controlled, fairly long-term meadows of timothy are probably the best use of the Hudson and other heavy or somewhat poorly drained soils.

RECOMMENDED VARIETIES AND RATES OF SEEDING

Corn. Cornell 29–3 is the best variety for silage on the highest elevations and for grain on the medium elevations. West Branch Sweepstakes is a good variety for silage on the Hudson lowland and up to elevations of about 1200 feet in the hills, and Cornell 11 at higher elevations. Both West Branch and Cornell 11 do best on "strong land". Both respond to the use of manure and superphosphate in southeastern New York.

Spring grain. Cornellian and Llenroc oats are the varieties recommended. A common rate of seeding is 8 pecks to the acre, but on "strong" land or where a heavy application of manure was made for the preceding crop, a seeding of 6 pecks may stand up better and yield more grain, especially in a wet season, than will an 8-peck seeding. Superphosphate applied heavily direct for oats should help to reduce lodging and to improve yields, and at the same time materially benefit the meadow seeding.

In situations where lodging is expected to be particularly serious, the Upright variety of oats is preferable to the others.

Meadow seeding mixtures. Under average conditions as to depth of soil and drainage on the Dutchess, Pittsfield, Bernardstown, Stockbridge, Cossayuna, and other soils, a good rate of seeding is 6 pounds of red clover, 4 of alsike, and 8 pounds of timothy to the acre. The red-clover seed should be hardy, northern-grown, domestic. It may need inoculation before being sown. Lime as needed, according to test of the soil, should be applied and thoroughly mixed with the soil before seeding. The lime requirements shown in table 4 are suggestive of the quantities likely to be needed for red clover.

On the gravelly and other well-drained soils such as Pittsfield or Dover, Troy, Albia, Hoosic, Merrimac, Cossayuna, Schodack, Claverack, and Copake, after liming sufficiently for it, 6 pounds of variegated, inoculated alfalfa may well replace the alsike clover in the above mixture.

On rather poorly drained areas that remain moist throughout the season, 6 to 8 pounds of alsike with 5 pounds each of timothy and redtop should produce fairly good hay. In time the timothy is likely to be displaced by redtop under these conditions.

On the Hudson silty clay loam and silt loam which may be rather wet in the spring and which becomes bone-dry in periods of low summer rainfall, mammoth clover, 8–10 pounds, and timothy 8 pounds to the acre, should prove a good meadow mixture, particularly on the less productive areas.

Alfalfa. The Hoosic, Cossayuna, Copake, Groton, Schodack, Otisville, Albia, Troy, Pittsfield or Dover, Merrimac, and Hinckley soils are generally well adapted for the growth of alfalfa. The Hoosic loam, where it joins the Hudson soils, and parts of the Claverack do not possess the subsoil drainage needed for alfalfa. Much of the Cossayuna, Pittsfield, and some of the Dutchess and other upland soils will carry alfalfa to good advantage. With the exception of some areas of Pittsfield soil, all of these soils require some lime for alfalfa. If more than 1½ tons is needed, the application should be divided, half being applied for the cultivated crop a year before plowing for alfalfa, and the remainder applied soon after plowing and stirred into the soil while preparing the seedbed for this crop. In this way the acidity is reduced sufficiently for alfalfa by the time it is seeded.

Ontario variegated and Grimm alfalfa may be expected to give best results over a period of years. Fifteen pounds of well-inoculated seed to the acre usually gives a good stand of alfalfa. For farm feed, 10 to 12 pounds of alfalfa, with 5 pounds of timothy in addition, gives good results Alfalfa may be seeded in June or July in the northern part of this area on well-prepared comparatively weed-free land, or in Cornellian oats sown at the rate of 5 or 6 pecks to the acre. Removing the oats for hay where possible is beneficial to the alfalfa. In the southern counties, seeding in late July and early August gives good stands.

Since alfalfa feeds heavily on phosphorus, this element should be supplied at a rate of not less than 150 pounds of 20-per-cent superphosphate to the acre a year, on the average, for the life of the stand. On soils well adapted for alfalfa, 400 to 600 pounds of 20-per-cent superphosphate to the acre at seeding time is a good application. The heavier rate usually produces more alfalfa than does the lighter one.

Except where the soil has been manured consistently over a period of years, 100 pounds of muriate of potash at seeding time and repeated every two or three years afterward is good practice on the more gravelly soils such as Hoosic, Copake, Claverack, Merrimac, Hinckley, Groton, Schodack Troy, Albia, and Otisville.

Buckwheat. The acreage of buckwheat has declined markedly in recent years, the present acreage being unimportant. Buckwheat needs phosphorus; about 150 pounds of 20-per-cent superphosphate to the acre is a good application. Manuring direct for buckwheat usually causes lodging. The crop occupies the same place that corn does in the rotation. Buckwheat needs 10 to 12 weeks from planting to maturity. The Japanese, common gray, and Silverhull varieties yield in the order stated The usual rate of seeding is 4 or 5 pecks to the acre for Japanese, and 3 pecks to the acre of the other varieties. Buckwheat does not control soil erosion as effectively on fairly steep slopes as do oats, meadow, or pasture, and is seldom a profitable crop.

Soybeans. The Cayuga soybean can be of real service to southeastern New York dairymen. Under conditions favorable for it, it produces a goodly yield of beans, the meal of which is high in protein and in oil The protein and oil in soybean meal are equal to or higher than in either cottonseed or linseed meal. When mixed with oats and corn and ground soybeans supply the protein needed in dairy rations.

Soybeans require the same seedbed and soil conditions as does corn and liming approximately as for red clover. Soybeans are planted some days after corn-planting time, since they require a warm soil for germination and growth. The Cayuga variety may be grown on the Hudson lowland and in favorable locations on the lower upland. The Black Eyebrow and Manchu may do even better than the Cayuga on the Hudson lowland, but they need a growing season extending up to October 1 In table 1 are indicated the average date for the first killing frost and the earliest killing-frost date. These dates and the length of the growing season may determine the soybean variety to use.

The Cayuga soybean is the one variety recommended for the higher

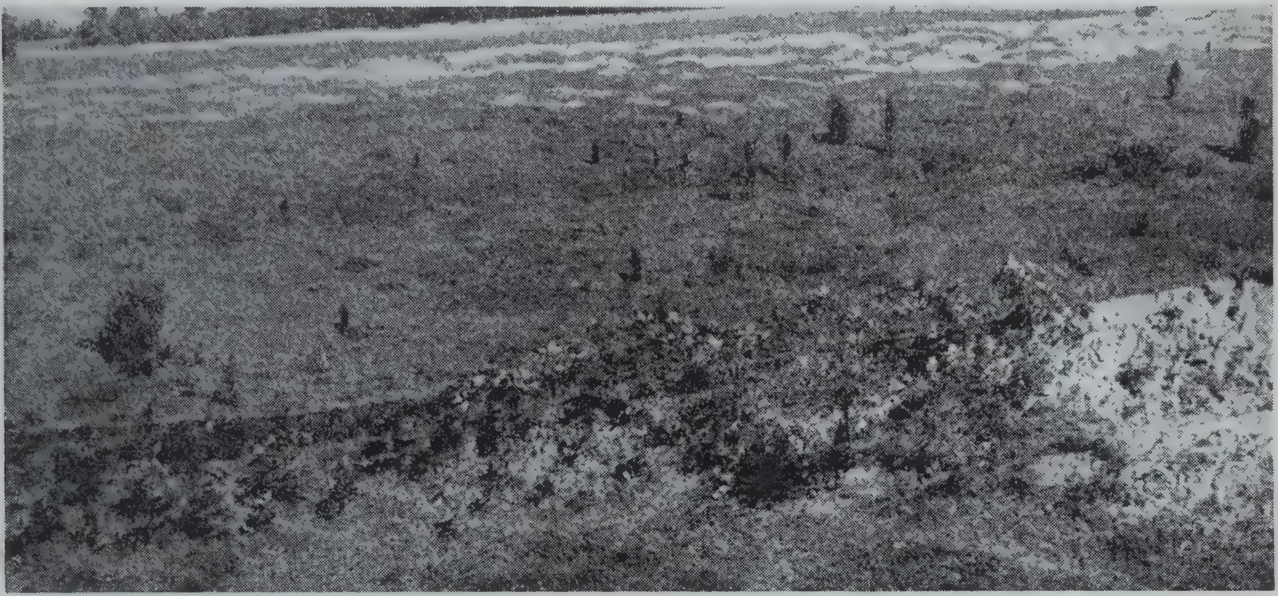

Figure 14. slipping of the hudson clay (background) in a columbia county pasture

elevations at present in the central Hudson Valley. On clean land it is drilled solid; that is, all drill holes open, at the rate of 6 to 8 pecks to the acre. On weedy land, planting less seed in rows 28 inches apart and cultivating are probably better practices. Special pains should always be taken to have the seedbed reasonably free of weeds before seeding. The seed requires inoculation before planting. When drilled solid the beans may be cultivated with a weeder or a peg-toothed harrow during the hot dry part of the day, when the plants are tough and resistant to injury.

PASTURES

Much of southeastern New York is particularly well adapted for the production of grasses for hay, for silage, and for pasture. The best lands no doubt produce better grass than do poor soils. Yet the most productive soil must be kept for growing the crops in which the farmer makes large investment in labor, seed, and soil treatment. Some land that is somewhat too poorly drained, or somewhat steeply sloping, or badly washed, or naturally not particularly productive may be taken out of cultivation. Such land may be used for grass. With proper treatment, seeding, and management these soils may be expected to yield good returns as pasture.

Like most crops, pasture grasses respond to good treatment. One or more legumes with the grasses are essential for good results. The pasture legumes, wild white clover, and ladino clover thrive on soils that are not very acid. On soils near or below a pH of 5.5, liming is essential for good growth of these legumes. They must make good growth, or they cannot supply the grasses with the nitrogen needed and the livestock with the protein required. Liming approximately as needed for red clover is good for these pasture legumes.

Legumes feed heavily on phosphorus, and without a plentiful supply of it they cannot make good growth. Applications of about 600 pounds an acre of 20-per-cent superphosphate repeated every four years are very beneficial after liming. The lime and phosphorus are equally beneficial to the livestock that grazes on pastures so treated.

A full discussion of pasture improvement and management is given in Cornell extension bulletin 393, by D. B. Johnstone-Wallace.

In seeding pastures the mixture should include such perennial legumes as wild white or ladino clover and long-lived perennial grasses such as Kentucky and Canada bluegrass, and timothy, orchard grass, and perennial rye grass.[11]

Wild bird's-foot trefoil is well established in the north central part of this area, particularly in Columbia and Albany Counties. Here the inclusion of a small quantity of wild bird's-foot trefoil seed appears to be well justified. Being a deep-rooting legume this plant does well even in droughty periods.

SPECIAL MANAGEMENT RECOMMENDED FOR GRAVELLY SOILS

The gravelly soils of southeastern New York include the Hoosic, Claverack, Copake, Troy, Albia, Merrimac, Schodack, Groton, and Otisville series. Much of the acreage of these soils is rather deficient in organic matter. This deficiency is especially marked in those areas which are growing orchard trees and which have been clean-cultivated over a considerable period of years, and also in those areas on which rye has been grown rather frequently. It is in the orchards on the coarser Hoosic soils in particular that this deficiency is showing its effect, owing to the inability of these soils to hold water (figure 6).

Everything feasible should be done to keep up a supply of active organic matter to aid these soils in holding water during periods of low summer rainfall. Such quantities of manure as are available should be applied to them, whether in orchard or other crops.

In orchards it may be necessary to go to the expense of seeding cover crops to be worked into the soil as organic matter. Rye, or rye and vetch, may be sown early in October, allowed to grow throughout the fall and early spring, and worked into the soil with a disc harrow the following spring. The growth of the cover crop should be stopped early enough so as not to use moisture that should be conserved for the use of the trees. Owing to the openness of these gravelly soils, green, succulent, organic matter decays and disappears from them rapidly. Consequently, it is essential that organic matter be turned under every year on these soils. Such organic matter may be expected to be of real value to the trees over a period of years.

If straw or other coarse material is available for a mulch under the trees, it is helpful in conserving moisture for the use of the trees.

In the younger orchards with much open space between the trees, alfalfa might be planted, but its probable competition with the trees for moisture should not be overlooked. The requirements of alfalfa have been outlined. If absolutely needed for the livestock, one crop might be removed for hay. The other crop, however, should be cut and forked over under the trees, where there is no alfalfa growing, to serve as a

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[11] Specific recommendations involving foreign seed cannot be made because of the present international situation. Current recommendations may be obtained from county agricultural agents or from extension agronomists.

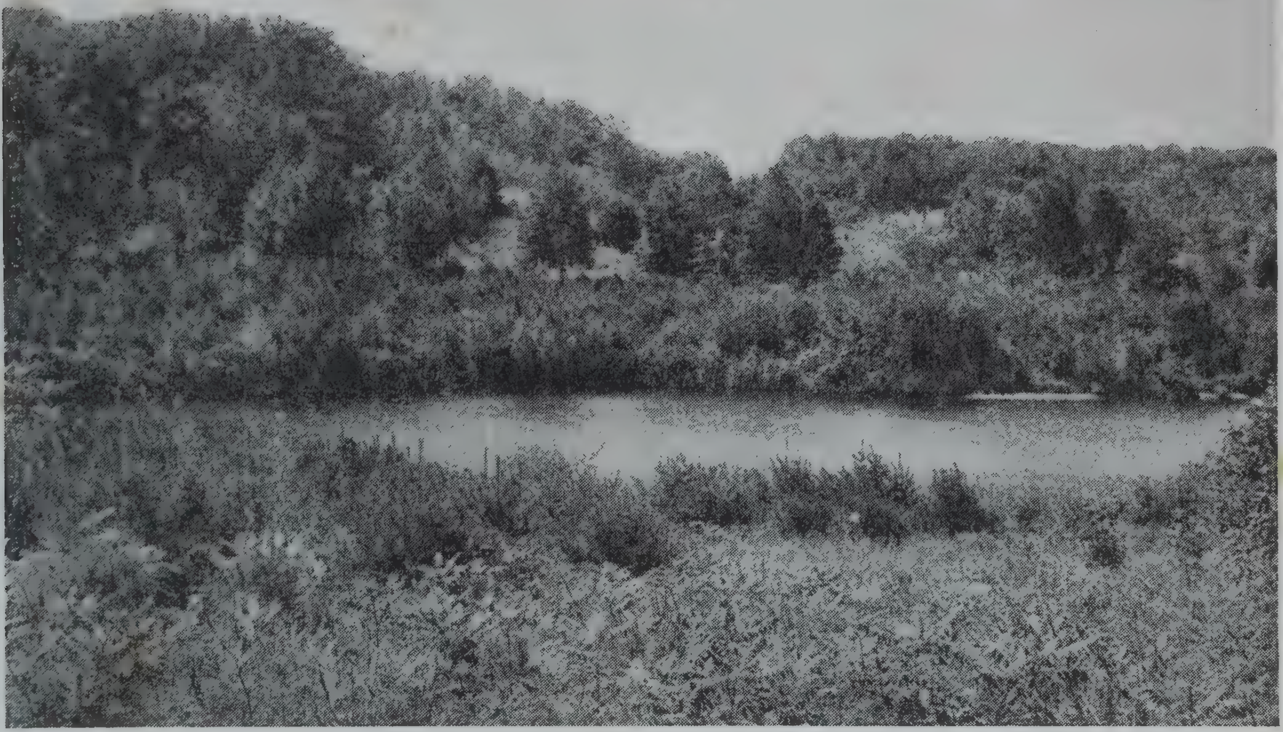

Figure 15. PINES AT THE HUDSON CITY WATER RESERVOIR

The pines bordering the far shore were planted to protect the soil against erosion, and are making good growth

mulch and as a source of nitrogen for the trees. The first cutting should be used for mulching purposes, and the second for hay. This fits the needs of the trees, and, moreover, the second cutting is more desirable for feeding purposes. Sweet clover may serve the same purpose in places.

Fruit growers in the area are referred to *Soils in Relation to Fruit Growing in New York;* Part VII, by L. P. Batjer and Joseph Oskamp (Cornell University Agricultural Experiment Station, Bulletin 627, 1935).

FORESTS AS A FARM CROP

In the hill section, private, as well as public reforestation, should be given serious attention. As the lands in pasture near the farm buildings are improved, the more distant and otherwise less accessible fields will not be needed unless the number of livestock on the farm is increased. The back fields, or those higher up, will be released by pasture improvement, and may be reforested. Information on tree planting, species adapted to various soil conditions, source of planting stock, and information on woodlot management may be obtained from county agricultural agents or from the extension foresters at the New York State College of Agriculture at Ithaca.

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December 1940

Marketing New York Livestock

W. M. Curtiss and E. H. Matzen

A CULL COW ON THE WAY TO MARKET

Livestock marketing in New York is largely the purchase and sale of dairy replacements, and the sale of cull cows and veal calves from dairy herds

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Photographs on cover and pages 13 and 23 are from Agricultural Advertising & Research Service, Inc.

MARKETING NEW YORK LIVESTOCK[1]

W. M. CURTISS AND E. H. MATZEN

Dairy herds provide more than one-half of the entire cash farm income of New York farmers. Other livestock, with the exception of poultry which is not discussed in this report, is of relatively minor importance (table 1). On January 1, 1940, the United States Department of Agriculture reported 2,116,000 cattle on New York farms, practically all of which were cows, heifers, calves, and bulls in dairy herds. The number amounted to about 12 animals per farm.

TABLE 1. LIVESTOCK ON NEW YORK FARMS*
January 1, 1940

Kind	Number (thousands)	Number per farm†
Dairy cows	1,437	8.1
Dairy heifers, 1–2 years	285	1.6
Dairy heifers under 1 year	268	1.5
Other cattle	126	0.7
Total cattle	2,116	11.9
Hogs and pigs	259	1.5
Sheep and lambs	332	1.9
Horses and mules	314	1.8

*United States livestock report, U. S. Agr. Dept.
†Based on 177,025 farms reported in the 1935 Census.

Hogs and pigs are raised chiefly for home butchering on New York farms, and on January 1 amounted to about 1.5 head per farm.

Sheep and lambs are largely in farm flocks and feeding flocks in the western part of the State. The number on hand January 1, 1940, was estimated at 332,000, or nearly two per farm.

Horses and mules are still an important source of power on New York farms, and averaged 1.8 head per farm.

As a source of cash income on New York farms, the sale of livestock accounted for more than 9 per cent of the total in 1939 (table 2). The sale of cattle, calves, beef, and veal amounted to $23,000,000, or about 7.5 per cent of the total cash income. Hogs, pork, and lard provided 1.3 per cent, and sheep, lambs, and wool, 0.6 per cent, of the total cash income.

Compared with some of the more important meat-producing States or with the United States as a whole, the sale of livestock in New York provides a smaller proportion of the cash farm income. In Iowa, for example, the sale of livestock accounted for nearly 60 per cent of the

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[1] This report is a condensation of studies made by both authors. More detailed reports are available in the following mimeographed publications of the Department of Agricultural Economics and Farm Management at Cornell University: *Community Livestock Auctions in New York State,* A. E. 265; *Number and Breed of Cows on New York Dairy Farms,* A. E. 283; *Marketing Replacements for New York Dairy Herds,* A. E. 286; *Selling New York Livestock Through Terminal Markets,* A. E. 289; *Replacements for Horses on New York Farms,* A. E. 302; *Marketing Cull Dairy Cows in New York State,* A. E. 310; and *Marketing Veal Calves in New York State,* A. E. 317.

Some of the material presented here was obtained from a thesis by E. H. Matzen entitled *Livestock Marketing in New York State,* presented to the Faculty of the Graduate School of Cornell University, September, 1939, in partial fulfillment of the requirements for the degree of doctor of philosophy.

TABLE 2. CASH FARM INCOME
New York State, 1939

Source of income	Cash farm income*	Proportion of total
	Dollars	*Per cent*
Crops	97,027,000	31.5
Livestock products and poultry:		
Milk	134,018,000	43.6
Eggs	29,402,000	9.5
Chickens and turkeys	12,024,000	3.9
Livestock:		
Cattle, calves, beef, and veal	23,297,000	7.6
Hogs, pork, and lard	4,072,000	1.3
Sheep, lambs, and wool	1,754,000	0.6
Other†	2,798,000	0.9
Government payments	3,265,000	1.1
Total	307,657,000	100.0

*Preliminary, U. S. Agr. Dept., Bur. Agr. Econ.
†Includes horses, mules, ducks, geese, and honey.

cash farm income in 1938. For the United States as a whole this source of income was 29 per cent of the total.

Because its importance is overshadowed by the marketing of other products, and because for an individual farmer the marketing of his livestock usually is not his biggest marketing problem, little organized effort has been directed toward the solution of the livestock-marketing problems of New York farmers.

The selling of dairy cows by farmers who raise more than their own requirements to farmers who buy some or all their replacements, the marketing of worn-out or cull dairy cows, and the marketing of veal calves, are probably the three most important livestock-marketing problems of New York farmers. The buying and selling of work horses and colts, of hogs and pigs, and of sheep, lambs, and wool, are also important on some farms.

HOW NEW YORK FARMERS MARKET THEIR LIVESTOCK

New York farmers live near large consuming centers of population. They have easy access to metropolitan New York with its 11,000,000 people. The upstate cities of Buffalo, Rochester, Syracuse, Albany, and Utica, as well as Binghamton and the surrounding urban area, each have a population in excess of 100,000 persons. In addition to these larger cities, there are a dozen smaller ones, each with more than 25,000 population.

These urban centers of population in New York State, as well as rural areas, provide a market for most of its livestock, and farmers have several methods for disposing of their livestock.

TERMINAL MARKETS

New York farmers are fairly well located with reference to terminal livestock-market facilities. On the west is the Buffalo market and in the southeast are the markets in New York City and in Newark and Jersey City, New Jersey, all serving the metropolitan area. The Buffalo market is one through which a large amount of stock moves toward eastern markets; more than half of the livestock handled at these yards in 1939 was shipped on to other markets. Compared with 67 public stockyards in the United States in 1939, 20 received more cattle, 10 received more calves, 25 received more hogs, and 13 received more sheep and lambs than did Buffalo.

The three markets serving the metropolitan area differ from the Buffalo market in that practically all of the receipts are slaughtered locally. Combined, they received considerably more stock than did Buffalo. They received more calves than did any other public stockyards in 1939. Only the Chicago and Denver market received more sheep and lambs and only at Chicago were more slaughtered. Four markets received more hogs and twelve received more cattle than did the three metropolitan markets combined.

Livestock sold at terminal markets is usually consigned to one of the several commission companies located at the market. It may pass through the yards even though it is consigned directly to packers. Commission companies perform the services of selling the livestock, as well as seeing that it is watered and fed according to the consignors' instructions. They render an accounting of the charges and receipts to their patrons.

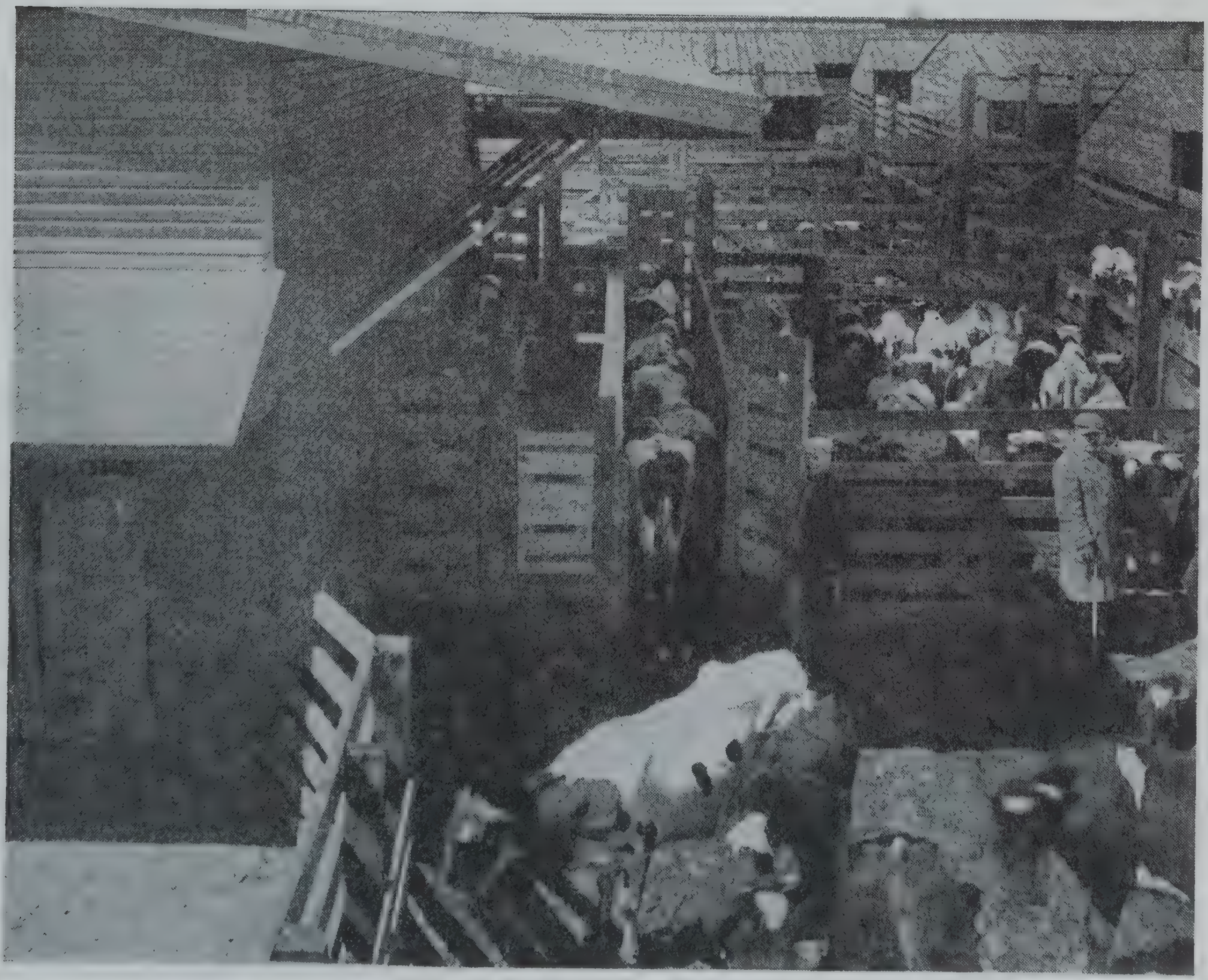

FIGURE 1. CULL DAIRY COWS AT THE BUFFALO STOCK YARDS

Ten years ago, the terminal livestock markets serving New York farmers received as high as 20 per cent of all the veal calves and 40 per cent of the cull cows marketed from New York dairy herds. In 1933, a state law prohibiting the sale of veal from calves less than three weeks of age, was repealed. Since this revision, terminal markets, and especially those in the New York metropolitan area, have received fewer live calves from New York than formerly. The slaughter of bob calves at a few days of age has increased. The shrinkage and death loss in shipping such calves is relatively high, and consequently a high proportion of this slaughtering is done in the country near the point of origin.

Terminal markets are still receiving around 40 per cent of the cull cows from New York herds. There has been a decrease at Buffalo, but this has been offset by a considerable increase at Jersey City.

Terminal-market charges differ slightly at different markets and with the size of shipment, whether shipped in by rail or truck, and whether the stock is fed in the yards. The total charges, including commission charges, yardage, feed, bedding, insurance, etc., amounted in 1937 to $1.65 to $2.00 per head for cattle; 55 to 75 cents for calves; 22 to 48 cents for sheep; and 45 to 82 cents for hogs.

In 1936–37, all of the calves, and 97 per cent of the cattle, sheep, and hogs received from New York State by one of the large commission firms at Buffalo arrived by truck. At Jersey City, 73 per cent of the cattle, 40 per cent of the calves, 86 per cent of the hogs, and only 3 per cent of the sheep from New York arrived by truck. The balance of the receipts at these markets arrived by rail.

At the Buffalo market, 89 per cent of the cattle, 96 per cent of the calves and sheep, and 81 per cent of the hogs came from within a radius of 100 miles, and practically all came from within 150 miles. At Jersey City, practically none of the sheep, only 35 per cent of the cattle, 20 per cent of the calves, and 29 per cent of the hogs came from within 100 miles. Eight per cent of the cattle, 35 per cent of the calves, 46 per cent of the sheep, and 5 per cent of the hogs came from distances greater than 200 miles.

LIVESTOCK DEALERS

The New York farmer's most important agent for handling his livestock is the dealer who comes to the farm to buy or sell livestock. A state law requires the licensing of any person who buys or sells more than 50 cattle a year.[2] These so-called cattle dealers usually handle all kinds of livestock. In addition to these, there are many specialized dealers, such as horse dealers or calf buyers, who are not required to be licensed.

Approximately 1000 cattle dealers are licensed in the State each year. It has been estimated that there are about as many more livestock dealers who are not licensed. These dealers are located generally throughout the State, but are more concentrated in the intensive dairy sections. With about one-third of these dealers, cattle dealing is a side line to their farming operation.

In making application for a license, cattle dealers are asked the number of different cattle handled during the preceding year. The dealers who were licensed in 1938–39 stated that they handled an average of 313 cattle each in 1937–38. The cow population in the State amounts to about 1500 per licensed dealer. With each dealer handling about 300 head a year, dealers buy and sell one cow for each five that farmers own.

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[2] Article 20-a, New York Agriculture and Markets Law.

Estimates indicate that dealers handle about half of the dairy-cow replacements that are sold from farmer to farmer in the State. They also buy about half of the cull dairy cows and veal calves sold by dairymen. They are probably less important in the sale of other kinds of livestock. More than half of the horses which farmers sell are sold directly to other farmers. Sheep production is near enough the Buffalo terminal market that farmers sell more than half of their sheep and lambs on that market. Hogs and pigs are sold largely from farmer to farmer without the assistance of a dealer.

LIVESTOCK BUTCHERS

Because of the large local outlets for meat in upstate New York, a considerable quantity of New York livestock is slaughtered by relatively small local butchering establishments. Most of the larger cities in New York have fairly large slaughtering establishments, but in addition to these, there are many small slaughterhouses which serve villages and small cities. Some of these butchers retail their meat in their own shops and others wholesale their meat to retailers.

Under Article 17 of the Agriculture and Markets Law, relating to the adulteration, packing, and branding of food and food products, the state commissioner of agriculture and markets has issued a series of regulations for slaughterhouses. These regulations refer to the construction

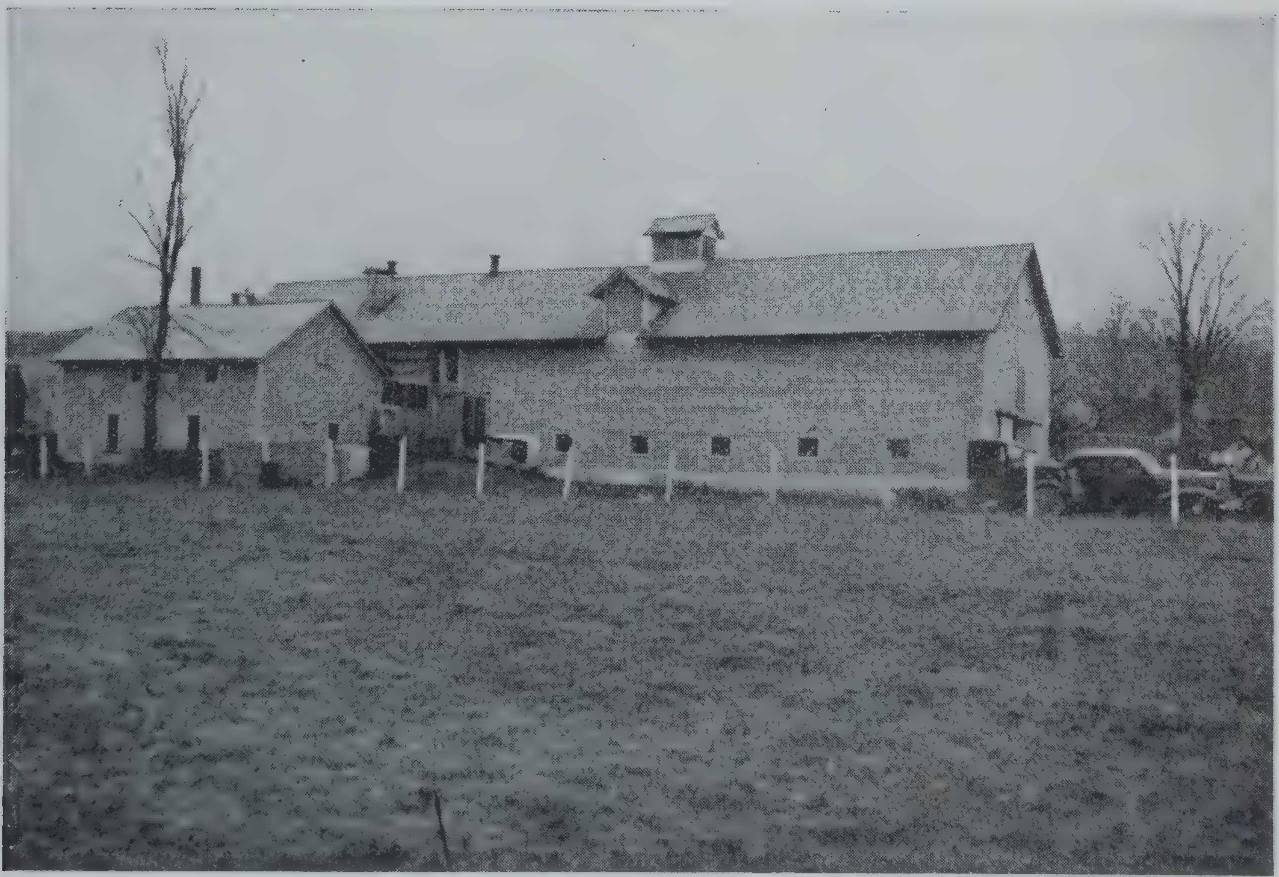

FIGURE 2. SLAUGHTER HOUSE WHICH WAS ONCE A MILK PLANT

and facilities required for slaughterhouses and to keeping them in a clean and sanitary condition. No state licensing of slaughtering establishments is required, and it has been difficult to obtain a reliable estimate of the number in operation in the State. An incomplete list of about 300 was prepared by the Department of Agriculture and Markets and it has been estimated that probably 500 are in operation in various parts of the State.

Most local butchers maintain their own slaughterhouses. A few slaughterhouses are used by more than one butcher, and some butchers hire their slaughtering done.

A study of 25 local butchers in 1937 indicated that in addition to buying and slaughtering animals on their own account they also buy and sell animals alive, and slaughter some animals for other butchers on a fee basis. The amount of livestock handled annually per butcher varied considerably but averaged around 300 head of cattle, 1850 calves, 160 hogs, and 450 sheep and lambs.

Farmers report that they sell 20 to 40 per cent of their cull dairy cows to butchers. In many instances they probably do not distinguish between a butcher and a cattle dealer. They report around 30 per cent of their calves and about 15 per cent of their hogs and sheep as sold to butchers.

Butchers obtain the bulk of their cattle, sheep, and hogs, around 80 per cent, direct from farmers. The remainder they obtain from livestock dealers and at auctions. A higher proportion of their calves, especially for northern New York butchers, are obtained from dealers.

COMMUNITY LIVESTOCK AUCTIONS

In 1939, 45 community livestock auctions were operated in 28 New York counties. These are public sales held at fairly regular intervals, usually weekly, to which any person may consign livestock of any description to be sold on a commission basis. Not included in this group of auctions are farm auctions, purebred-cattle sales held annually or semiannually, the purebred-Holstein sale held monthly at Earlville, or auction sales held by cattle dealers in which only their own stock is sold.

Most of the auctions, and especially the larger ones, are located in central New York, outside of the area where movement of livestock to the terminal markets at Buffalo and Jersey City is important.

Practically all of the auctions now in operation started either during or since the depths of the depression in 1932. Only one large auction now in operation started prior to 1930. The expansion of this movement may not yet have ended. There were ten more auctions operating in 1939 than in 1938. The mortality of such ventures has been fairly high and it seems doubtful if the number in operation will increase much beyond the present number.

Auctions have usually been started by cattle dealers; some of the managers carry on a private cattle trade in conjunction with their auction operations. Some of the auctions are operated by a partnership consisting of a cattle dealer and an auctioneer. None is operated by a cooperative corporation.

The volume of livestock handled by auctions varies so much that averages are of little significance. Nine auctions in 1938 handled an aver-

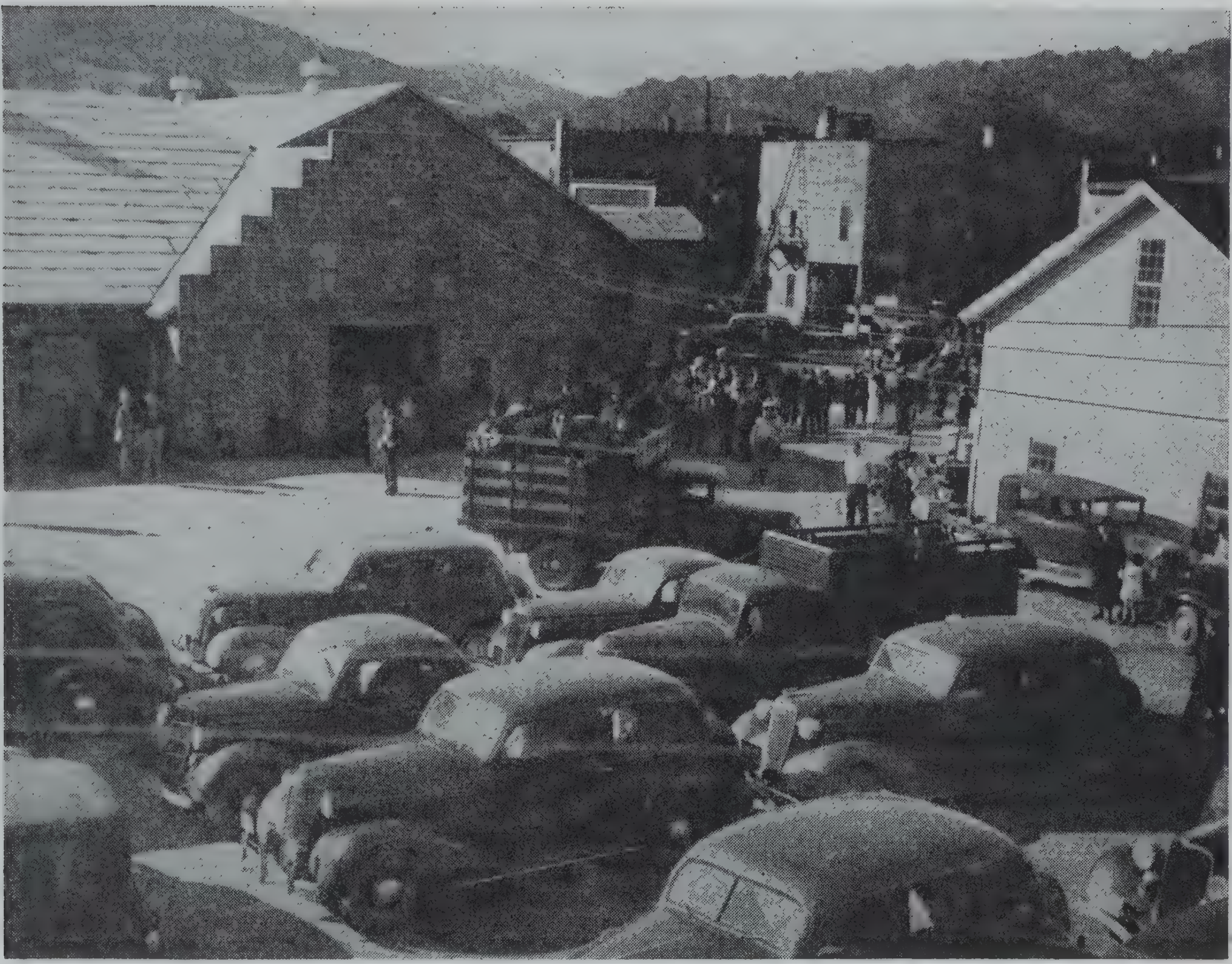

Figure 3. sale day at one of new york's larger livestock consignment auctions in the heart of the business district of a small village

age of more than 100 head of cattle per sale; six auctions handled less than 20. The largest one handled 200 head per sale. Auction managers reported that about half of the cows handled were for dairy replacements and half were cull dairy cows.

One auction reported an average of 450 calves handled at each sale. Eight handled more than 100 per sale, and 10 averaged less than 25 head per sale. Most of the calves handled were bob calves sold at a few days of age.

Sheep, hogs, horses, and live poultry constituted a minor portion of the offerings at most of the auctions.

The usual commission charged for selling stock at auctions is 5 per cent. For calves, sheep, and hogs, the higher rate of 7 or 10 per cent is sometimes charged. A few auctions charge 7 per cent for cattle and horses, but the trend appears to be toward lower rates. Auction managers indicated that farmers consigned about half of the livestock sold at their auctions, and dealers and auction managers consigned the other half. The important buyers at auctions are dealers, butchers, and small packers. Farmers buy some of the dairy cows for replacements, and some of the horses and pigs offered.

As a general rule, the cows for dairy replacements offered at these auction sales are not of the best quality. They bring prices little higher than they would as meat animals. This is not always true; some fairly good cows are offered at these sales. There is considerable variation in the quality of dairy cows offered at different auctions.

MARKETING DAIRY REPLACEMENTS

An average of about 240,000 dairy cows have had to be replaced annually on New York farms for the past ten years. This represents from 17 to 18 per cent of the total number of cows on hand, and indicates a complete turnover in herds every five to six years. For the most part, these replacements are provided by heifers raised on New York farms. For the past six years, imports of cows for dairy purposes have practically balanced exports at a relatively low figure. In 1938, about 6000 head were imported, largely from Canada and the Central West, and about the same number exported, mostly to the New England States.

To replace from 17 to 18 per cent of the dairy cows each year, nearly one-half of all the heifer calves born in the State are started on the road toward making a dairy heifer. Because of differences in economic conditions in different parts of the State and because of differences in individual dairymen, dairy replacements are not raised uniformly throughout the State in proportion to the needs for those replacements. As a result, there is a considerable movement of dairy cows from district to district, county to county, and from farm to farm within counties.

Surveys have indicated that about one-third of the cows in New York dairy herds are purchased from other New York herds. There is considerable variation between different sections of the State in the proportion of the cows in the herds purchased. In the northern and southwestern sections of the State, where dairying is less intensive and where more summer dairying prevails, farmers raise a high proportion of their replacements. In southeastern New York and in other areas where farmers have more favorable milk markets and operate a more intensive dairy enterprise, there is a tendency to buy more of the needed replacements for their herds. In some sections, it is usual to purchase nearly all of the dairy replacements.

TABLE 3. FARMS WITH VARYING PROPORTIONS OF COWS RAISED
5013 New York farms, January 1, 1939
(Mail questionnaire)

Cows raised	Farms		Cows per farm	Cows bought in 1938 per 100 kept
Per cent	*Number*	*Per cent*	*Number*	*Number*
None	442	9	12	41
1–19	204	4	26	30
20–39	429	9	19	20
40–59	615	12	18	12
60–79	832	17	19	8
80–99	960	19	21	3
100	1,531	30	15	0
All farms	5,013	100	18	10

In nine per cent of the herds represented in a mail questionnaire,[3] all of the cows were purchased (table 3). Thirty per cent had raised all of their cows. Two-thirds of the farms had raised 60 per cent or more of their cows. The average size of the herds in which none of the cows were raised was 12 cows, and of herds where all were raised, 15 cows; both groups were below average in size. An average of 10 cows were bought in 1938 for each 100 cows on hand January 1, 1939, but the number varied from 41 per hundred for those herds where none were raised to none where all were raised.

For more than half of the herds no purebreds were reported. Twelve per cent of these farmers raised none of their cows, and 33 per cent had raised the entire herd. For the herds which were entirely purebred, fewer farmers raised none and more farmers raised all of their cows than was true of grade herds.

Despite the fact that in 41 per cent of the small herds (4 cows or less) all of the cows were raised, there was considerably more activity in buying and selling per 100 cows kept than in larger herds (table 4). Nineteen cows were bought per 100 kept, as compared with an average

TABLE 4. RELATION OF SIZE OF HERD TO NUMBER OF COWS BOUGHT AND SOLD
5013 New York farms, 1938
(Mail questionnaire)

Cows per herd	Proportion of herds with all cows raised	Cows bought in 1938 per 100 kept	Production cows sold in 1938 per 100 kept
Number	*Per cent*	*Number*	*Number*
0–4	41	19	34
5–9	34	13	13
10–14	33	10	9
15–19	30	9	8
20–24	27	8	7
25–29	24	8	6
30–39	16	7	6
40–49	16	12	6
50 and more	15	12	5
All farms	30	10	8

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[3] The information which follows in this report was obtained largely from four sources:

1. A personal visit was made to 350 farmers in four areas of the State in 1937 to obtain information relative to their marketing of all livestock for 1936–37. The counties in which records were taken were Chautauqua, representing southwestern New York; St. Lawrence, representing northern New York; Onondaga, representing central New York; and Orange, representing southeastern New York. This study will be referred to as the *farm survey*.

2. A mail questionnaire was sent to 29,000 farmers by county agricultural agents in January, 1939. This questionnaire, designed to obtain information on the amount of livestock marketed and methods of marketing during 1938, was filled out and returned by about 5350 farmers, or 18 per cent of those receiving them. This will be referred to as the *mail questionnaire*.

3. A high-school survey was made covering the year 1938, in which 148 agricultural teachers in 45 counties cooperated. Their students, representing 2461 farms, supplied information on age, weight, method of marketing, and price of livestock bought and sold during 1938 on a farm with which they were familiar.

4. Data were obtained from the books of one commission company at each of the two major terminal markets serving New York State—Buffalo and Jersey City. The information covered the period August 1936 through July 1937.

For one week of each month detailed information was procured on each sale giving the amount and kind of livestock received, date and month of arrival, transportation used, origin, number of animals of each kind in the consignment, weights, prices received, marketing charges, and type of buyer. On the remaining market days of each month the information pertaining to weights, prices, charges, and buyers was omitted.

Non-detailed information obtained at Buffalo represented 13 per cent of the cattle, 21 per cent of the calves, 39 per cent of the sheep, and 19 per cent of all hogs received at Buffalo, originating in New York State. At Jersey City, the sample included 55 per cent of the cattle, 34 per cent of the calves, 38 per cent of the sheep, and 41 per cent of the hogs coming from the State. Detailed information was obtained on more than one-fifth of the total sales made by each commission company.

of 10 for all herds; and 34 were sold as compared with an average of 8 for all herds. The larger the herds, the fewer the number of cows sold for production per 100 kept.

The average price paid for replacement cows in 1938 was $81 (table 5). One-third of the cows were bought at between $60 and $80 per head, and about one-fourth between $80 and $100; 18 per cent were bought for less than $60, and an equal number for between $100 and $120. Only 8 per cent cost more than $120, averaging $137 per head.

TABLE 5. REPLACEMENT COWS BOUGHT AT DIFFERENT PRICES
2017 cows, New York, 1938
(High-school survey)

Price paid per head		Cows bought		Average weight	Average age
Range	Average				
Dollars	*Dollars*	*Number*	*Per cent*	*Pounds*	*Years*
Less than 60....	45	363	18	888	5.0
60 to 80........	70	655	32	960	4.6
80 to 100.......	87	479	24	1,009	5.0
100 to 120......	103	353	18	1,022	5.2
120 and more...	137	167	8	1,049	4.9
All cows........	81	2,017	100	977	4.9

Cows that were above average in cost averaged more than 1000 pounds in weight, whereas the cheaper cows were lighter in weight. There was little difference in the average age of the cows in the various price groups.

About two-fifths of the cows were four or five years old when purchased, and cost an average of $87 each (table 6). As the age increased beyond this, the price declined. Relatively few cows were bought beyond the age of seven years. There was little difference in the average weight of the various age groups, except for the youngest group which averaged 2.6 years of age and less than 900 pounds.

TABLE 6. REPLACEMENT COWS BOUGHT AT DIFFERENT AGES
2017 cows, New York, 1938
(High-school survey)

Age		Cows bought		Average weight	Average price
Range	Average				
Years	*Years*	*Number*	*Per cent*	*Pounds*	*Dollars*
Under 4............	2.6	499	25	873	74
4 or 5..............	4.5	855	43	1011	87
6 or 7..............	6.3	506	25	1007	80
8 or 9..............	8.2	110	5	1013	77
10 or more.........	10.9	47	2	1032	76
All cows...........	4.9	2017	100	977	81

When the cows were grouped according to their weights, those weighing less than 700 pounds cost only $60, and the cost increased regularly as the weight increased. Those weighing 1300 pounds or more cost $97 per head as compared with the average price of $81

FIGURE 4. FUTURE DAIRY REPLACEMENTS

Home-grown dairy heifers provide the necessary replacements for milking herds on many farms, and are an important source of cash income on others

In Orange County 58 per cent of the cows bought were within one month of freshening, and 30 per cent were within one month after freshening. In contrast, St. Lawrence farmers bought only 6 per cent within one month of freshening and the same number within a month after freshening. In the areas with a more favorable milk market, a larger proportion of the cows bought were nearer freshening. In general, higher prices were paid for cows near the time of freshening.

On the mail questionnaire, information on origin was given for approximately 4600 replacement cows bought. In the southwestern, northeastern, and southern districts, at least 85 per cent of all cows bought originated within the county; in contrast, only 44 per cent in the southeastern district, and 60 per cent of those bought in the central district came from the local county (table 7). In five of the districts, more than 90 per cent of the cows bought came from the home district or from a county adjoining the home

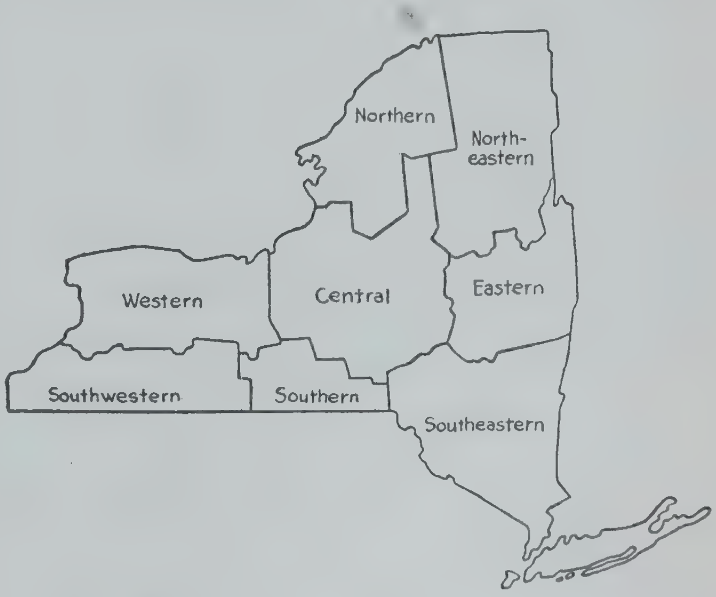

FIGURE 5. DISTRICTS OF NEW YORK STATE

The State was divided into eight geographical districts each including the following counties:

Northern: St. Lawrence, Jefferson, Lewis.
Northeastern: Franklin, Clinton, Essex, Warren.
Western: Niagara, Orleans, Monroe, Wayne, Erie, Genesee, Wyoming, Livingston, Ontario, Yates, Seneca.
Central: Oswego, Oneida, Herkimer, Cayuga, Onondaga, Madison, Cortland, Chenango, Otsego.
Eastern: Fulton, Saratoga, Washington, Montgomery, Schenectady, Schoharie, Albany, Rensselaer.
Southwestern: Chautaqua, Cattaraugus, Allegany, Steuben.
Southern: Schuyler, Tompkins, Chemung, Tioga, Broome.
Southeastern: Delaware, Sullivan, Ulster, Greene, Rockland, Columbia, Dutchess, Orange, Westchester, Nassau, Suffolk.

TABLE 7. ORIGIN OF REPLACEMENT COWS
1001 New York farms, 1938
(Mail questionnaire)

District	Number of cows bought	Origin					
		Local county	Local district or adjoining county*	Other parts of New York	Canada	Other States	All origins
		Per cent of cows bought					
Northern	402	77	14	3	6	..	100
Northeastern	171	88	9	..	3	..	100
Western	797	65	26	8	†	1	100
Central	1,069	60	18	9	13	†	100
Eastern	613	75	12	11	..	2‡	100
Southwestern	368	90	7	2	..	1§	100
Southern	248	85	9	2	..	4‖	100
Southeastern	921	44	15	23	3	15¶	100
All districts	4,589	66	16	10	4	4	100

*Not including local county.
†Less than 0.5 per cent.
‡Largely from New England.
§Largely from Ohio.
‖All from Pennsylvania.
¶Largely from Central West.

county. In southeastern New York, 23 per cent came from other parts of the State; 3 per cent came from Canada; and 15 per cent came from other States, mostly in the Central West. In the central district, 9 per cent came from other parts of New York and 13 per cent from Canada; while in the eastern district, 11 per cent came from other parts of the State and 2 per cent from the New England States.

In the mail questionnaire, the method of buying was given for nearly 9000 production cows. Fifty-two per cent of them were bought from farmers, 42 per cent from dealers, 4 per cent at consignment auctions, and 2 per cent at purebred auctions (table 8). There was considerable variation between districts in the percentage of cows bought by the differ-

TABLE 8. METHODS OF BUYING REPLACEMENT COWS
5262 New York farms, 1938
(Mail questionnaire)

District	Number of cows bought	Method of buying					
		Farmers	Dealers	Consignment auctions	Purebred auctions	Other	Total
		Per cent of production cows bought					
Northern	703	73	22	1	1	3	100
Northeastern	196	76	19	4	..	1	100
Western	1,322	51	44	3	2	*	100
Central	2,479	47	44	6	3	*	100
Eastern	1,132	59	38	3	*	..	100
Southwestern	611	63	32	3	2	..	100
Southern	537	52	42	3	3	..	100
Southeastern	2,017	42	51	4	3	*	100
All districts	8,997	52	42	4	2	*	100

*Less than 0.5 per cent.

ent methods. In the two northern districts, more than 70 per cent of the cows were purchased from farmers, while only 42 per cent were bought in that way in the lower New York district, where half of their cows were bought from dealers. In the central district, 6 per cent of the cows were bought at consignment auctions. All districts, with the exception of the northeastern, reported some purchases at purebred auctions.

In general, the larger a dairyman's herd, the more he relies upon cattle dealers as a source of the dairy cows he buys. Farmers with herds of less than 5 cows bought 68 per cent of their cows from farmers and 27 per cent from dealers. For herds of 10 cows or more, about half of the replacements were bought from farmers and 43 per cent from dealers.

Two-thirds of the cows that were purchased came from the county in which the farmer lived. Of these, 70 per cent were bought from farmers and 26 per cent from dealers. The farther the farmers had to go to purchase cows the more they relied on dealers for their supplies. Canadian cattle might be considered an exception in that 74 per cent were purchased from farmers and only 20 per cent from dealers. The bulk of Canadian cattle were purchased by farmers in counties bordering on Canada, and in Oneida County.

An analysis of the sales of dairy replacements showed relationships similar to the analysis of purchases. The cows sold averaged 5.5 years of age, or about one-half year older than those purchased. The average weight was slightly more, and the average price was $78, as compared with $81 for purchased cows. Increased prices were received for cows of a younger age, greater weight, and near freshening.

The methods used in selling cows for production were similar to those used in buying. Slightly more cows were sold to dealers and fewer directly to farmers. Forty-nine per cent of the 6800 production cows sold were bought by dealers; selling direct to farmers accounted for 45 per cent, while 3 per cent were sold through each type of auction (table 9).

TABLE 9. METHODS OF SELLING REPLACEMENT COWS
5262 New York farms, 1938
(Mail questionnaire)

District	Number of cows sold	Method of selling					
		Farmers	Dealers	Consignment auctions	Purebred auctions	Other	Total
		Per cent of production cows sold					
Northern	849	48	48	2	2	..	100
Northeastern	281	26	74	..	..	..	100
Western	936	48	49	1	2	..	100
Central	1,757	46	46	5	3	*	100
Eastern	688	61	37	2	*	..	100
Southwestern	905	34	63	1	2	..	100
Southern	511	38	58	2	2	..	100
Southeastern	900	46	38	6	10†	..	100
All districts	6,827	45	49	3	3	*	100

*Less than 0.5 per cent.
†All from two farms.

The northeastern, southwestern, and southern districts sold 58 per cent or more of their cows to dealers; these same districts also were highest in number of cows sold for production per 100 cows kept. Selling to dealers was least important in the eastern and southeastern districts, where the fewest production cows were sold. In the eastern district, 61 per cent of the cows were sold direct to farmers, while in the northeastern district only 26 per cent were sold in this way. Selling through consignment auctions accounted for approximately 5 per cent of the cows sold in central and lower New York.

The higher the percentage of the cows in the herd that were purebred, the less farmers relied on dealers to move the replacements they had to sell, and the more they sold directly to farmers.

The number of heifers bought and sold per farm is not great. Farms included in the mail questionnaire bought about 6 heifers and sold 4 for every 10 farms. The methods of purchase and sale were similar to those for dairy cows.

MARKETING CULL COWS

Approximately 200,000 cull dairy cows have been sold annually from New York farms in recent years. These include cows rejected for tuberculosis, Bang's disease, mastitis, old age, and low production, but do not include those sold for dairy replacements.

The annual sale of 200,000 cull dairy cows represents about 14 per cent of the number of cows on hand at the beginning of each year. These cows are mostly of a cutter or canner grade. If it were assumed that New York cull cows bring about $45 each, the total annual sales would amount to about $9,000,000, or about $50 per farm. A farm with a 20-cow dairy would normally turn off about 3 cull cows a year, worth $135. This amounts to nearly half of the total cash income from the sale of livestock from New York farms; the balance is from the sale of cows for dairy purposes, calves, hogs, sheep, and wool.

The 5262 farms represented in the mail questionnaire kept an average of 18 cows per farm; the number varied from 12 in the western to 23 in the southeastern district (table 10). Approximately 20 cows were sold

TABLE 10. COWS SOLD FOR PRODUCTION AND SLAUGHTER
5262 New York farms, 1938
(Mail questionnaire)

District	Cows per farm	Number of cows sold–		
		For production	For slaughter	Total sold
		Per 100 on hand		
Northern	22	8.1	11.3	19.4
Northeastern	17	11.2	8.4	19.6
Western	12	7.6	12.5	20.1
Central	21	7.7	12.5	20.2
Eastern	17	6.6	12.7	19.3
Southwestern	16	11.1	10.7	21.8
Southern	14	9.7	12.9	22.6
Southeastern	23	5.6	14.6	20.2
All districts	18	7.7	12.5	20.2

for each 100 on hand. There was little variation between districts in the total number sold, but there was considerable variation in the proportion sold for dairy purposes and for slaughter. In the southeastern district, about three-fourths of those sold went for slaughter, while in the northeastern and southwestern districts less than half of those sold were for slaughter. Where a farmer has a market for dairy cows and can raise them to advantage, it would appear that although he may sell no more cows per 100 on hand, he may sell a higher proportion of them while they are still useful for dairy purposes.

With 14 per cent of the cows in dairy herds sold for slaughter each year, a high percentage of relatively young cows must be included among them. In the farm survey, the average age of cull cows sold was 7 years. About one-third of them were less than 6 years old, one-third were 6 to 8 years old, and 17 per cent were 10 years or more of age.

In New York dairy-herd-improvement associations from 1933 to 1938, the average age of cows disposed of from dairy herds was 5.2 years. These included cows sold for dairy purposes, as well as slaughter cows. About one-fourth of the cows were two and three years of age; three-fourths were 6 years old or less; and only 5 per cent were 10 years old or more.

On the mail questionnaire, the reason for selling was given for more than 10,000 cows sold for slaughter. The most common reason given was udder trouble, accounting for one-third of those sold (table 11). Low production was the second most important reason, while Bang's disease and old age each accounted for 14 per cent of the cows sold. The percentage sold because of udder trouble was relatively uniform between districts, ranging from 27 to 37 per cent. In the southern district, 30 per cent of the cows were sold because of Bang's disease. Old age was given as the reason for selling approximately one-fifth of the cows in the northern, northeastern, and southwestern districts. Areas with more favorable milk markets sold fewer cows for that reason.

TABLE 11. REASONS FOR SELLING SLAUGHTER COWS
5262 New York farms, 1938
(Mail questionnaire)

District	Number of cows sold	Reason for selling								
		Udder trouble	Low production	Bang's disease	Old age	Sterility	Accident	T.B.	Other	Total
		Per cent of slaughter cows sold								
Northern.........	1,048	31	13	12	18	8	6	6	6	100
Northeastern.....	214	35	21	9	24	8	3	..	..	100
Western..........	1,382	27	19	12	16	15	7	1	3	100
Central..........	2,696	37	14	16	13	11	5	3	1	100
Eastern..........	1,174	34	18	13	15	11	7	1	1	100
Southwestern.....	767	35	16	11	19	10	8	*	1	100
Southern.........	634	28	15	30	11	9	5	1	1	100
Southeastern.....	2,172	37	18	13	10	12	5	4	1	100
All districts.......	10,087	34	16	14	14	11	6	3	2	100

*Less than 0.5 per cent.

Weight is the most important factor affecting the returns from cull cows. An analysis of the receipts of cattle by a large commission firm at both Buffalo and Jersey City for one week of each month for the year 1936–37, included 1827 cattle at Buffalo and 4899 at Jersey City. The average weight of cows and heifers received at Buffalo was 938 pounds; those at Jersey City averaged 981 pounds, 43 pounds heavier (table 12). Cows and heifers weighing between 800 and 1000 pounds accounted for more than 40 per cent of the receipts at both markets. At Jersey City, 38 per cent of the receipts were between 1000 and 1200 pounds, while at Buffalo only 30 per cent were in this group. The difference in weight can be largely accounted for by the areas from which each market obtained receipts. Buffalo receipts came from areas of less intensive dairying where more cows of the lighter breeds are kept.

TABLE 12. RECEIPTS AND PRICES OF COWS AND HEIFERS OF VARIOUS WEIGHTS
Buffalo and Jersey City livestock markets, 1936–37*

Weight	Proportion of receipts		Average weight		Average price per cwt.	
	Buffalo	Jersey City	Buffalo	Jersey City	Buffalo	Jersey City
Pounds	*Per cent*	*Per cent*	*Pounds*	*Pounds*	*Dollars*	*Dollars*
Under 600	3	1	517	553	4.94	4.66
600 to 800	18	11	713	740	5.65	4.19
800 to 1000	41	43	900	919	4.71	4.73
1000 to 1200	30	38	1081	1074	4.91	5.03
1200 to 1400	7	6	1267	1259	5.25	5.81
1400 or more	1	1	1448	1482	5.30	6.38
All weights	100	100	938	981	4.97	4.91

*Based on data for one week of each month.

The average prices for cows and heifers in the 800-to-1000-pound group were nearly equal. For the heavier weights, average prices at Jersey City were 50 cents to one dollar higher per hundredweight, while at Buffalo, higher prices were paid for the younger and smaller animals. In general, higher prices were received with each increase in weight. Some exception, however, in the lower weights is probably accounted for by the young animals which are in the lower weight groups.

Cull dairy cows are marketed throughout the year. About 45 per cent of the receipts at Buffalo and Jersey City came during the months of March, April, May, and June. The lightest receipts came in the late summer and early fall months. In the northern counties where summer dairying prevails, a large proportion is marketed at the close of the pasture season.

In the mail questionnaire, farmers were asked to indicate where they thought their cull cows were slaughtered. Answers to this question represented more than 9000 cows. In the northern, western, and southwestern districts, Buffalo was indicated as the most important destination for slaughter cows sold (table 13). Jersey City was the most important destination given for cows from the southeastern district. In the central and eastern districts, local cities in that part of the State provided their chief outlet. Pennsylvania was an important destination for cows sold from the southern district.

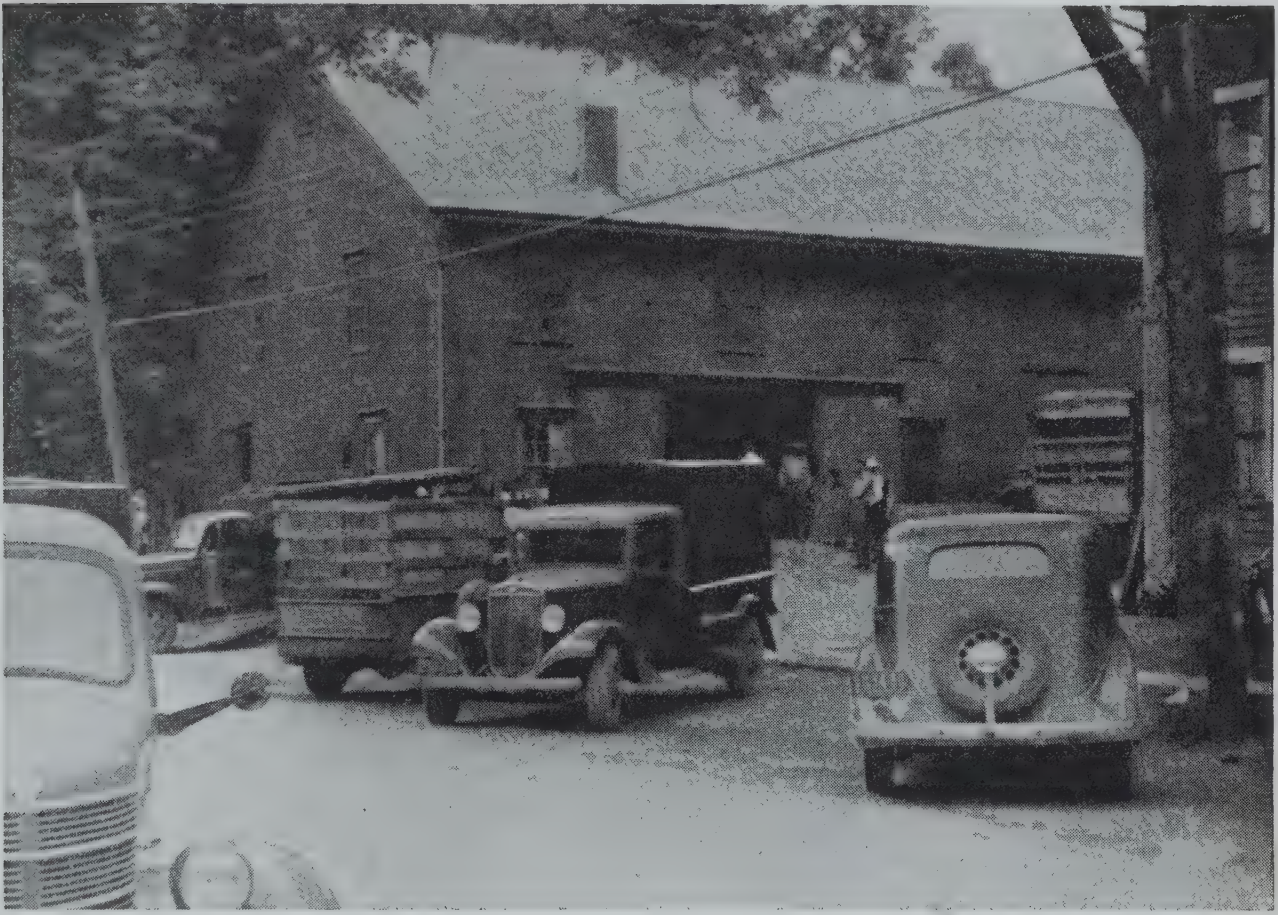

FIGURE 6. ONE OF NEW YORK'S SMALLER LIVESTOCK AUCTIONS IN AN OLD BARN IN A SMALL VILLAGE

TABLE 13. PROBABLE DESTINATION OF SLAUGHTER COWS
5262 New York farms, 1938
(Mail questionnaire)

District	Number of cows	Destination					
		Local	Terminal markets		Local up-state cities	Out of State	All destinations
			Buffalo	Jersey City			
		Per cent of cows sold					
Northern	878	29	43	3	24	1	100
Northeastern	184	45	5	9	26	15	100
Western	1,365	14	68	*	18	..	100
Central	2,371	32	1	11	51	5	100
Eastern	1,178	30	..	19	47	4	100
Southwestern	775	12	82	2	1	3	100
Southern	596	45	6	2	16	31	100
Southeastern	1,910	35	..	57	6	2	100
All districts	9,257	29	22	18	27	4	100

Less than 0.5 per cent.

For the State as a whole, 40 per cent went to terminal markets. This figure agrees closely with the estimate of the total number of New York cull cows sent to Buffalo and Jersey City (page 6).

In the mail questionnaire farmers reported the method of selling for 11,000 slaughter cows. More than 80 per cent of the slaughter cows were sold to dealers and butchers; a few more were bought by dealers than by butchers (table 14). Selling through commission companies accounted for 11 per cent of the cows sold; 5 per cent were sold at auctions and 3 per cent were sold directly to packers.

TABLE 14. METHODS OF SELLING CULL COWS
5262 New York farms, 1938
(Mail questionnaire)

District	Number of cows sold	Method of selling					
		Dealers	Butchers	Commission companies	Consignment auctions	Packers	Total
		Per cent of slaughter cows sold					
Northern	1,143	58	30	4	7	1	100
Northeastern	211	53	41	2	4	..	100
Western	1,538	29	31	37	*	3	100
Central	2,945	35	53	1	8	3	100
Eastern	1,298	41	48	3	5	3	100
Southwestern	896	40	18	38	2	2	100
Southern	657	29	59	3	2	7	100
Southeastern	2,339	58	27	6	8	1	100
All districts	11,027	42	39	11	5	3	100

*Less than 0.5 per cent.

Differences in the distance from terminal markets and the nearness of large centers of population caused considerable variation between districts in the method of marketing. In the western and southwestern districts, adjacent to the Buffalo Terminal Market, approximately 38 per cent of the cows were sold through commission companies. In the western district, however, with larger cities, 31 per cent of the cows were sold to butchers, compared with only 18 per cent sold in this way in the southwestern district. The central, southern, and eastern districts were highest in the percentage sold to butchers. Northern, central, and southeastern districts each sold approximately 8 per cent of their cows through auctions. The percentage sold to packers was highest in the southern district of the State, where many were sent to Pennsylvania.

It would appear that even though large number of cows from southeastern New York go to metropolitan markets, farmers sell them to dealers rather than send them direct to market as many do in western New York.

MARKETING VEAL CALVES

The production of veal calves in New York is largely a side line in the production of milk on dairy farms. Nevertheless, the income from the sale of veal calves is an important item and amounts to more than half the value of cull cows sold.

It has been estimated that between 600,000 and 700,000 veal calves are sold annually from New York farms. This is based on the estimate that the number of calves born is about equal to 90 per cent of the number of cows and heifers 2 years old and over. Less than 60 per cent of the calves born are sold for veal; about 15 per cent die or are killed at birth for their hides; and 30 per cent are raised for dairy cows and bulls. The percentage sold for veal varies from farm to farm and section to section within the State, depending largely on the number of heifer calves retained for replacements.

During the late 1920's the terminal livestock markets at Buffalo and Jersey City received about 20 per cent of the veal calves sold from New York farms. Since then, the proportion has gradually declined until the present receipts amount to only about 8 per cent of the number sold. The decline has been largely at Jersey City, with Buffalo receipts declining only slightly. The receipts at Jersey City declined from about 13 per cent of the total to less than 2 per cent. The Buffalo market continued to receive around 6 per cent throughout the 1930's. Receipts of New York calves at the 41st Street market in New York City are not available for recent years.

Buffalo is in an area where small dairy herds predominate, and the practice of fattening the calves for market is prevalent. Jersey City, on the other hand, serves a more intensive dairy area where there is an increasing tendency to sell the calves at birth. Bob calves which are shipped alive to market are subject to a relatively high shrinkage and some death loss. This has encouraged the practice of country dressing, and explains, to a considerable extent, the decline in receipts at Jersey City.

The fact that the Jersey City market receives fewer New York calves than formerly does not necessarily mean that the metropolitan area is taking a smaller percentage of New York calves than formerly. A larger amount of country-dressed veal is received in the city, offsetting to some extent lower receipts of live calves. The total number of pounds of veal received from New York State is probably less, owing to the younger average age at which calves are marketed.

Prior to July 1, 1933, it was unlawful to sell veal from a calf less than 3 weeks of age at the time of killing. There were apparently two major reasons for the change in the law in 1933. One was the feeling by many persons that the age of a calf had little if any influence on the healthfulness of the meat. The second reason was the reported widespread violation of the law with respect to age limit.

The so-called "baby veal" law passed in 1933 removed the restriction of selling veal from calves butchered under three weeks of age, but specified that such veal be plainly tagged as baby veal.[4] The same law requires that retail establishments selling such veal display a sign to that effect, and that hotels, restaurants, and other eating places serving baby veal display such a sign and also print it on the bill-of-fare.

New York City receives a large amount of dressed veal, as well as live calves. Some is "western-dressed" and some is from near-by areas. Veal is usually dressed with the hide left on, the head off, and certain vital organs left attached for inspection purposes. The New York City Department of Health requires that all veal carcasses coming into New

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[4] Article 5, Sections 91–93, of the New York State Agriculture and Markets Law.

York be inspected either by the United States Department of Agriculture or by New York City inspectors.

The city's only requirement is that the veal be "fit for human food;" no specifications as to age are made. Inspectors report that the chief reason for rejection of veal carcasses is emaciation.

From the mail questionnaire, it was found that calves sold per farm varied from approximately 8 in the western and southern districts to about 15 in the northern and southeastern districts (table 15). The average for the State was 11.6 per farm, and the number of cows per farm averaged about 18. Calves sold per 100 born varied from 62 to 78, being lowest in the southern district and highest in the western district.

TABLE 15. DAIRY CALVES SOLD
5262 New York farms, 1938
(Mail questionnaire)

District	Number of calves sold—			Per cent of calves sold—			
	Total	Per farm	Per 100 born	To raise	As bobs	As veal	Total
Northern	7,326	15.1	74	9	84	7	100
Northeastern	1,622	10.8	66	11	78	11	100
Western	7,958	7.9	78	11	43	46	100
Central	15,265	13.4	72	10	81	9	100
Eastern	7,111	11.4	75	9	72	19	100
Southwestern	5,354	10.3	68	10	59	31	100
Southern	2,997	8.1	62	12	71	17	100
Southeastern	10,600	15.0	73	10	79	11	100
All districts	58,233	11.6	72	10	72	18	100

Seventy-two per cent of the calves were sold as bobs (less than 2 weeks old); 18 per cent were sold as veal; and 10 per cent were sold to be raised. The percentage sold to be raised varied little between districts. There was considerable variation, however, in the percentage of calves sold as veal. In the western district, 46 per cent, and in the southwestern district, 31 per cent, of the calves were sold as veal. In the northern district, only 7 per cent were vealed.

In the high-school survey, the average weight of 7890 veal calves reported was 106 pounds (table 16). The average weight varied consid-

TABLE 16. WEIGHT AND PRICE OF VEAL CALVES SOLD IN DIFFERENT DISTRICTS
7890 calves, New York, 1938
(High-school survey)

District	Calves sold		Average weight	Price received	
				Per head	Per cwt.
	Number	*Per cent*	*Pounds*	*Dollars*	*Dollars*
Northern	872	11	88	4.39	4.98
Northeastern	337	4	86	4.86	5.65
Western	1,701	22	141	12.67	8.99
Central	1,510	19	89	4.87	5.46
Eastern	908	12	101	6.54	6.50
Southwestern	1,201	15	113	7.56	6.70
Southern	554	7	107	7.44	6.95
Southeastern	807	10	82	4.90	5.95
All districts	7,890	100	106	7.28	6.90

erably between districts because of differences in practices in feeding the calves. In western New York, where a large percentage of calves are fatted, the average weight was 141 pounds. In northern, central, and southeastern New York, the average weight was less than 90 pounds, indicating that most calves are sold as bobs at a very young age. Prices were 50 cents to one dollar per hundredweight lower in the northern district for calves of an average weight than prices for calves of a similar weight in the northeastern, central, and southeastern districts.

FIGURE 7. SPECTATORS AT A LIVESTOCK AUCTION

Among the crowds at New York State livestock auctions are many who are there out of curiosity and for entertainment

The calves recorded in the high-school survey were sold at an average age of 18 days (table 17). About one-quarter of the calves were sold at four days or less of age and about one-third at around one week old. The average weight increased with an increase in age from 78 pounds for those averaging 3 days old to 189 pounds for those more than 60 days old.

The price received per hundredweight increased steadily from about $5.00 to $9.70 as the age increased up to 6 weeks. Beyond that, the groups probably included some "grass" calves from which milk had been withheld, and which the market discounts.

From the terminal-market study it was found that Jersey City received a larger proportion of lightweight calves than did Buffalo; the average

TABLE 17. WEIGHT AND PRICE OF VEAL CALVES SOLD AT VARIOUS AGES
7890 calves, New York, 1938
(High-school survey)

Age		Calves sold		Average weight	Price received	
Range	Average				Per head	Per cwt.
Days		*Number*	*Per cent*	*Pounds*	*Dollars*	*Dollars*
1– 4	3 days	2,146	27	78	3.90	4.97
5–11	1 week	2,456	31	86	4.46	5.22
12–18	2 weeks	916	12	95	5.59	5.87
19–25	3 weeks	259	3	119	8.24	6.94
26–32	4 weeks	665	9	134	11.48	8.56
33–39	5 weeks	248	3	144	13.43	9.32
40–46	6 weeks	578	7	166	16.11	9.69
47–53	7 weeks	115	2	184	17.07	9.30
54–60	8 weeks	322	4	184	17.12	9.32
61 and more	18 weeks	185	2	189	16.85	8.93
All ages	18 days	7,890	100	106	7.28	6.90

weight at Buffalo was 140 pounds, while at Jersey City it was 127 pounds (table 18). Thirty-four per cent of the calves received at Jersey City weighed less than 100 pounds, while Buffalo handled only half as large a percentage of that weight. Buffalo received a larger proportion of calves weighing between 120 and 140 pounds and also a larger proportion heavier than 180 pounds.

TABLE 18. RECEIPTS AND PRICES OF CALVES OF VARIOUS WEIGHTS
Buffalo and Jersey City livestock markets, 1936–37*

Weight	Proportion of receipts		Average weight		Average price per cwt.	
	Buffalo	Jersey City	Buffalo	Jersey City	Buffalo	Jersey City
Pounds	*Per cent*	*Per cent*	*Pounds*	*Pounds*	*Dollars*	*Dollars*
Under 80	5	14	69	69	4.94	5.82
80 to 100	13	20	87	88	6.28	7.04
100 to 120	10	13	106	108	7.76	8.29
120 to 140	18	11	128	130	9.44	9.96
140 to 160	19	14	147	150	10.35	11.11
160 to 180	17	19	167	170	10.74	11.63
180 to 200	11	6	185	184	10.76	10.41
200 to 220	4	1	203	210	10.17	8.80
220 or more	3	2	245	287	9.39	7.83
All weights	100	100	140	127	9.61	9.60

*Based on data for one week of each month.

At Jersey City, highest prices were paid for calves weighing between 160 and 180 pounds; at Buffalo highest prices were received for calves weighing 180 to 200 pounds. The prices of calves weighing 160 to 180 pounds were twice as great as those received for calves weighing less than 80 pounds. The Buffalo market seemed to pay higher prices for heavy calves, while Jersey City paid higher prices for lightweight calves.

The fact that Buffalo receives a larger number of farm shipments of livestock than Jersey City does is illustrated by the number of animals received in each shipment. At Buffalo, 26 per cent of the cows were in consignments of a single animal, while in Jersey City, only 2 per cent arrived in such small consignments. Calves arriving in consignments of only one head accounted for 27 per cent of the Buffalo receipts and only 6 per cent of the Jersey City receipts, while calves arriving in consignments of 5 or more head accounted for only 35 per cent of Buffalo receipts, compared with 72 per cent at Jersey City.

In the mail questionnaire, the method of selling was given for more than 44,000 calves sold for slaughter. Dealers bought more than one-half of the calves, butchers about one-third; 6 per cent were sold at consignment auctions, and 3 per cent were sold through commission companies (table 19). In the northern district, 69 per cent of the calves were sold to dealers, only 15 per cent to butchers, and 16 per cent at consignment auctions. In contrast, the southern district sold only 42 per cent to dealers, but 54 per cent to butchers, and only 1 per cent at consignment auctions. Selling through commission companies was more important in the two districts in the western part of the State than in other districts.

TABLE 19. METHODS OF SELLING VEAL CALVES
5262 New York farms, 1938
(Mail questionnaire)

District	Number of calves sold	Method of selling					
		Dealers	Butchers	Consignment auctions	Commission companies	Other	Total
		Per cent of calves sold					
Northern	5,674	69	15	16	*	*	100
Northeastern	1,272	68	26	5	*	1	100
Western	5,555	42	39	*	14	5	100
Central	10,916	51	40	7	1	1	100
Eastern	5,634	48	44	6	1	1	100
Southwestern	3,848	68	19	1	9	3	100
Southern	2,720	42	54	1	1	2	100
Southeastern	8,546	61	29	8	1	1	100
All districts	44,165	55	34	6	3	2	100

*Less than 0.5 per cent.

MARKETING HORSES

Horses are and will continue to be an important source of power on New York farms for many years. There is an average of nearly two horses per farm the State over. Horsepower has been and is being subjected to intense competition from motorized equipment. Its use in cities for draft purposes and in both urban and rural areas for transportation has practically disappeared. The chief remaining use of horsepower is on farms for draft purposes.

The number of horses and mules on New York farms reached a high point of nearly 700,000 around 1895. The number remained higher than 600,000 until 1910. The gradual decline since has reduced the number to about 300,000, or less than half of the number formerly on farms. The number of horses per farm in New York was about 2.7 until after 1920. With the decline in total numbers, the number per farm has been reduced to 1.8, or about one-third.

For the United States as a whole, the number of horses and mules on farms increased until 1918 when a total of nearly 27 million was recorded. There has been a decline every year since 1918 and on January 1, 1940, the number of horses and mules on farms totaled about 15 million, or a decline of 43 per cent. At the high point in horse numbers in the United States, there was an average of about 4 horses per farm. This has declined to about 2.2 per farm at the present time.

When horses are relatively low in price, breeders are discouraged from raising colts. This causes a scarcity of horses at a later date and prices improve, encouraging the raising of colts. From 1920 to 1930, horse prices were relatively low and horse numbers were decreasing rapidly. Since 1930, the price of horses, relative to other commodities, has increased so that the raising of colts in the United States has been stimulated, and for the past three years there have been about 6 horse colts per 100 horses. This number of colts, while probably not enough to stop the decline in horses, will slacken it considerably.

The average price of horses on New York farms from 1910 to 1914 was $177 per head. Since that time, horses have never reached so high a price. A low of $118 was reached in 1924 and another low of $111 in 1932. In 1937 prices had recovered to $164, the highest since 1918. Prices declined during 1938 and 1939 and at the end of 1939 were about $140 per head or about 80 per cent of pre-war prices.

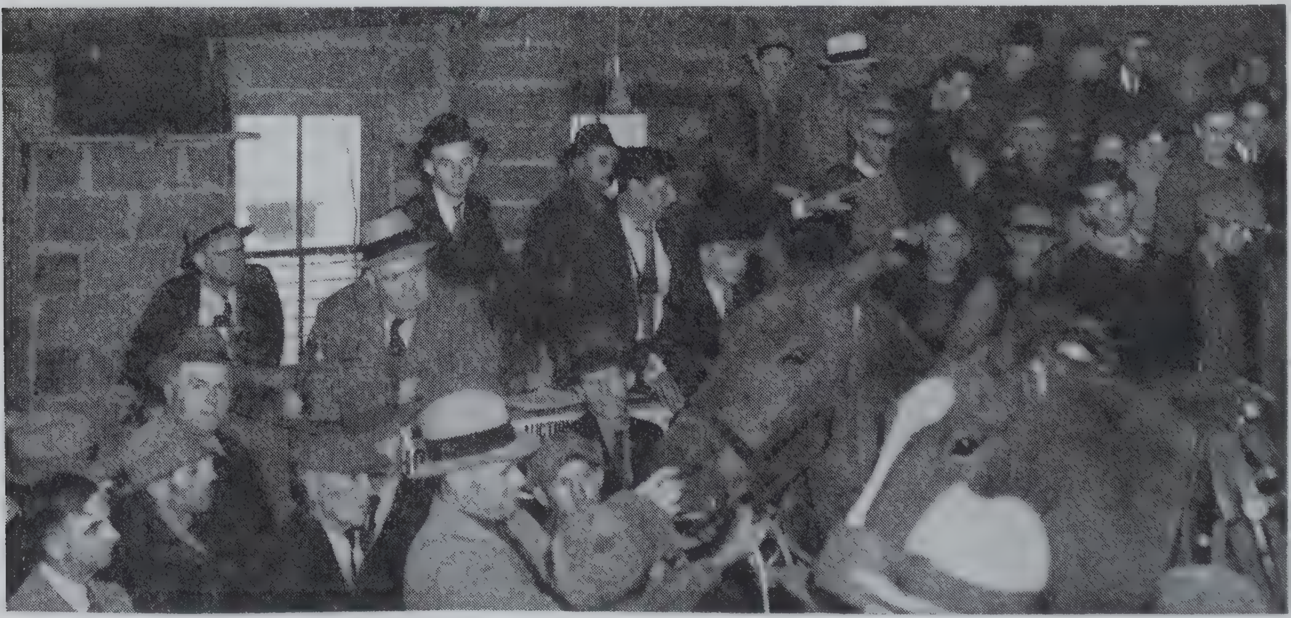

FIGURE 8. A PORTION OF THE CROWD, THE AUCTIONEER, AND THE SALE MANAGER LOOKING ON WHILE A TEAM OF HORSES IS BEING SOLD AT ONE OF NEW YORK'S LIVESTOCK AUCTIONS

The increasing interest in raising colts in recent years has been felt in New York, as indicated by increased stallion enrollments. According to Article 6 of the Agriculture and Markets Law, stallions used for public service must be licensed annually. From 1932, enrollment increased from 354 to 548 head in 1938.

With approximately 300,000 horses in New York, and assuming the useful life of a horse under present New York farm conditions to be about 12 years, the annual replacements required to maintain present numbers would be 25,000 horses. During the past 10 years, horse numbers have declined at an average rate of about 5000 per year. The number of replacements required in the future will be less than 25,000 if this decline continues. Likewise, the trend toward longer useful life reduces the number of replacements required.

New York farmers produce part of their horse replacements. The 1935 census indicated that about 6000 farms had approximately 9000 colts under 2 years of age. It is likely that practically all of these were born in New York. This would amount to 4500 colts born annually, or about 1.5 colts per 100 horses. On the basis of horses working 12 years, with numbers declining at the rate of 5000 per year, and about 5000 colts raised, the annual imports of horses into New York would be about 15,000 annually.

In the replies to the mail questionnaire, 5250 farmers reported 13,715 horses, or 2.6 per farm (table 20). There was a variation from 2.3 per farm in southeastern New York to 3.0 in western New York.

TABLE 20. HORSES AND COLTS ON NEW YORK FARMS
5250 New York farms, January 1, 1939
(Mail questionnaire)

District	Farms	Horses kept		Colts per 100 horses*	Proportion of horses	
		Total	Per farm		Raised	Bought
	Number	*Number*	*Number*	*Number*	*Per cent*	*Per cent*
Northern.........	504	1,290	2.6	11.7	21	79
Northeastern......	158	394	2.5	15.5	21	79
Western..........	1,048	3,136	3.0	13.6	19	81
Central...........	1,207	3,223	2.7	8.3	11	89
Eastern..........	655	1,578	2.4	8.7	12	88
Southwestern	543	1,409	2.6	18.2	16	84
Southern.........	390	972	2.5	8.5	15	85
Southeastern......	745	1,713	2.3	5.7	6	94
All districts.......	5,250	13,715	2.6	10.7	14	86

*Colts included all animals not broken for work.

The question asked about the number of colts on hand was intended to include all animals that had not been broken for work. The number reported was 1467, or 10.7 colts per 100 horses on hand. If it were assumed that this was three crops of colts, then 3.5 colts per 100 horses would have been born annually. From recent census data, this figure appears to be higher than the average for the State as a whole. The greatest concentration of colts was in the northern and western areas of the State.

The farmers reported that 14 per cent of their horses on hand had been raised and the remainder purchased. Not all of those purchased came from out of the State. The districts where the highest percentage were raised were also the districts with the most colts on hand. Two-thirds of the horses bought were geldings and one-third were mares.

The 5000 farmers replying to the mail questionnaire reported about 2000 horses purchased during 1938. This amounted to an average of slightly less than one-half horse per farm. The number of horses purchased amounted to 15.5 per 100 horses on hand (table 21). This num-

TABLE 21. NUMBER OF HORSES BOUGHT AND SOLD

5250 New York farms, 1938
(Mail questionnaire)

District	Horses bought		Horses sold	
	Number	Per 100 kept	Number	Per 100 kept
Northern	180	14.0	79	6.1
Northeastern	75	19.0	35	8.9
Western	414	13.2	221	7.1
Central	546	16.9	197	6.1
Eastern	238	15.1	95	6.0
Southwestern	226	16.0	160	11.4
Southern	129	13.3	70	7.2
Southeastern	323	18.9	145	8.5
All districts	2,131	15.5	1,002	7.3

ber varied from 13 in western and southern to 19 in northeastern and southeastern New York.

The horses that were bought for less than $50 averaged 1270 pounds in weight, were 17 years old, and their average cost was $28 (table 22). Horses costing $200 or more averaged 1493 pounds and were about 6.5 years of age; their average price was $220. The average weight was less than 1400 pounds, and the average age more than 10 years for all horses costing less than $100, while the average weight was more than 1400 pounds and the average age less than 7 years for all horses bought at $150 or more. The average weight increased and the average age decreased with increases in price.

TABLE 22. HORSES BOUGHT AT DIFFERENT PRICES

471 horses, New York, 1938
(High-school survey)

Price paid per head		Horses bought		Average weight	Average age
Range	Average				
Dollars	*Dollars*	*Number*	*Per cent*	*Pounds*	*Years*
Less than 50	28	10	2	1,270	17.1
50 to 100	73	61	13	1,333	11.8
100 to 150	121	158	34	1,456	8.4
150 to 200	161	133	28	1,421	6.7
200 or more	221	109	23	1,493	6.4
All prices	147	471	100	1,435	8.2

In the high-school survey, 50 per cent of the horses bought were 4 to 8 years old (table 23). Horses less than 4 years of age accounted for 5 per cent of the horses bought, while 8 per cent were 15 years old or more.

Horses 15 years old or more were lowest in average weight, weighing 1351 pounds, while the 4- and 5-year-olds were heaviest, averaging 1487 pounds. All other ages weighed between 1390 and 1440 pounds. Prices per head for the different age groups ranged from $77 for the oldest age group to $178 for horses 4 and 5 years old.

From the replies to the mail questionnaire, the method of buying was indicated for 2034 horses. Fifty-eight per cent of the horses were

TABLE 23. HORSES BOUGHT AT DIFFERENT AGES
471 horses, New York, 1938
(High-school survey)

Age		Horses bought		Average weight	Price paid
Range	Average				
Years	*Years*	*Number*	*Per cent*	*Pounds*	*Dollars*
Less than 4	2.8	24	5	1,393	148
4 and 5	4.6	112	24	1,487	178
6 and 7	6.5	124	26	1,440	162
8 and 9	8.4	83	18	1,440	142
10 to 15	11.6	91	19	1,403	124
15 or more	16.8	37	8	1,351	77
All ages	8.2	471	100	1,435	147

bought from dealers, 37 per cent from farmers, and 5 per cent at consignment auctions (table 24). The proportion bought from dealers varied from 41 per cent in the northeastern to 65 per cent in the southeastern district. In the two northern districts, more than one-half of the horses were bought from farmers. In the southeastern district, 11 per cent of the horses were indicated as bought at consignment auctions. Some of these horses were probably bought at dealer auctions, which usually sell relatively few consigned horses.

TABLE 24. METHODS OF BUYING HORSES
5250 New York farms, 1938
(Mail questionnaire)

District	Number of horses bought	Method of buying			
		Dealers	Farmers	Consignment auctions	Total
		Per cent of horses bought			
Northern	169	46	52	2	100
Northeastern	74	41	54	5	100
Western	388	53	41	6	100
Central	522	64	33	3	100
Eastern	228	57	39	4	100
Southwestern	209	56	41	3	100
Southern	120	56	43	1	100
Southeastern	324	65	24	11	100
All districts	2,034	58	37	5	100

The mail questionnaire indicated that farmers sold, on the average, about half as many horses as they bought during the year. The 5000 farmers who replied sold 1000 horses, or about one for every 5 farms. This amounted to 7.3 horses sold per 100 horses on hand (table 21). This made their net purchases amount to 8 or 9 per 100 horses kept. The sale of geldings only slightly outnumbered the sale of mares.

Thirty-four per cent of the horses were sold because of old age (table 25). These horses averaged more than 20 years in age and brought only $55 each. Horses which were said to have physical defects sold for $83 per head. These horses averaged about 16 years of age and weighed

TABLE 25. HORSES SOLD BECAUSE OF OLD AGE OR DEFECTS
350 New York farms, 1936–37
(Farm survey)

Condition or defect	Horses sold		Average weight	Average age	Price received
	Number	*Per cent*	*Pounds*	*Years*	*Dollars*
No defect	38	57	1297	12.0	122
Old age	23	34	1230	21.5	55
Physical defects*	6	9	1338	15.7	83
All horses	67	100	1278	15.3	92

*Includes crippled, bad feet, poor legs, blind.

over 1300 pounds. Horses for which no defect was stated averaged 12 years old, and the price per head was $122.

In the high-school survey, 54 per cent of the horses sold were over 10 years of age; of these about one-half were over 15 years of age (table 26).

TABLE 26. HORSES SOLD AT DIFFERENT AGES
243 horses, New York, 1938
(High-school survey)

Age		Horses sold		Average weight	Price received
Range	Average				
Years	*Years*	*Number*	*Per cent*	*Pounds*	*Dollars*
Less than 4	2.7	26	10	1,502	159
4 and 5	4.4	28	12	1,528	180
6 and 7	6.4	25	10	1,496	173
8 and 9	8.5	33	14	1,523	158
10 to 15	12.2	68	28	1,358	107
15 or more	19.8	63	26	1,348	55
All ages	11.1	243	100	1,427	121

Fourteen per cent of the horses were 8 and 9 years old. The remaining 32 per cent were about equally divided among the younger age groups.

TABLE 27. METHODS OF SELLING HORSES
5250 New York farms, 1938
(Mail questionnaire)

District	Number of horses sold	Method of selling				
		Farmers	Dealers	Consignment auctions	Other	Total
		Per cent of horses sold				
Northern	77	51	49	..	...	100
Northeastern	34	71	29	..	..	100
Western	213	58	40	..	2	100
Central	193	46	48	5	1	100
Eastern	93	50	44	2	4	100
Southwestern	158	54	45	..	1	100
Southern	66	56	42	2	..	100
Southeastern	140	36	57	4	3	100
All districts	974	50	46	2	2	100

Horses less than 10 years old weighed about 1500 pounds, while those over 10 years old averaged approximately 1350 pounds.

Prices per head for the different age groups ranged from $55 for the oldest horses to $180 for those 4 and 5 years old. Horses under 4 sold for $159 per head, about the same price as 8- and 9-year-olds. The 6- and 7-year-olds brought $173, only $7 less than horses 4 and 5 years old.

Method of sale was given for 974 horses in replies to the mail questionnaire. Half of these were sold to farmers and 46 per cent to dealers (table 27). Other methods of sale were relatively unimportant. Only 36 per cent of those in the southeastern district were sold to farmers.

MARKETING HOGS

Hogs are raised on New York farms primarily for home slaughter. Near cities there are farms where hogs are fattened on garbage, stale bread, and the like. On January 1, 1940, it was estimated that there were 259,000 hogs on New York farms or about 1.5 hogs per farm. These are fairly evenly distributed over the State. Some farmers follow the practice of keeping a few sows to raise pigs to sell to their neighbors. In northern New York, it is not uncommon to find a dairyman who separates his milk, sends the cream to a creamery and feeds the skimmilk to hogs. Some send their whole milk to a cheese factory and obtain whey to feed their hogs.

From the mail questionnaire it was found that the number of hogs and pigs bought per farm averaged 1.4 and the range was from 1.1 to 1.8, the greatest number bought per farm being in the western district (table 28). Eighty-eight per cent of the hogs and pigs were bought from farmers; 9 per cent were bought from dealers; and only 3 per cent were bought at consignment auctions. In all areas except the southeastern district, 80 per cent or more of the hogs and pigs were bought from farmers; 29 per cent were bought from dealers in that district. The number bought from dealers in the northeastern district was relatively high. In the northern

TABLE 28. Methods of Buying Hogs and Pigs
5262 New York farms, 1938
(Mail questionnaire)

District	Hogs and pigs bought		Method of buying				
	Total	Per farm	Farmers	Dealers	Consignment auctions	Other	Total
			Per cent of hogs bought				
Northern	762	1.5	88	4	7	1	100
Northeastern	170	1.1	80	19	1	..	100
Western	1,927	1.8	93	5	2	*	100
Central	1,639	1.4	89	4	7	*	100
Eastern	929	1.4	94	6	*	*	100
Southwestern	620	1.1	96	4	*	..	100
Southern	438	1.1	92	8	..	..	100
Southeastern	1,026	1.4	67	29	4	..	100
All districts	7,511	1.4	88	9	3	*	100

*Less than 0.5 per cent.

and central districts, 7 per cent of the hogs and pigs were bought at auctions; in no other area were auctions so important.

The number of hogs and pigs sold per farm averaged 3.3 and ranged from 2.1 in the southeastern district to 4.9 in the western district (table 29). Sixty-two per cent of all hogs and pigs reported were sold to farmers. Butchers bought 12 per cent of the hogs and pigs; dealers bought 8 per cent; an equal proportion were sold through commission companies; 6 per cent were sold directly to packers; and 2 per cent were sold at consignment auctions. The northern district, selling 11 per cent through auctions, was the only district in which this method was important. In the eastern district, 12 per cent of the hogs were sold to packers. In the western and southwestern districts, 18 per cent of the hogs were sold through commission companies at the terminal market. Dealers were a more important outlet in northern New York than in the other districts.

TABLE 29. METHODS OF SELLING HOGS AND PIGS
5262 New York farms, 1938
(Mail questionnaire)

District	Hogs and pigs sold		Method of selling							
	Total	Per farm	Farmers	Butchers	Dealers	Commission companies	Packers	Consignment auctions	Other	Total
			Per cent of hogs sold							
Northern	1,809	3.6	53	16	16	*	3	11	1	100
Northeastern	391	2.5	84	9	4	..	3	..	..	100
Western	5,161	4.9	57	9	8	18	7	1	*	100
Central	3,319	2.7	69	11	7	5	4	2	2	100
Eastern	2,665	4.0	64	18	4	..	12	1	1	100
Southwestern	1,549	2.8	64	9	6	18	1	1	1	100
Southern	1,029	2.6	75	7	8	7	2	1	*	100
Southeastern	1,559	2.1	57	15	7	2	6	1	12	100
All districts	17,482	3.3	62	12	8	8	6	2	2	100

*Less than 0.5 per cent.

MARKETING SHEEP, LAMBS, AND WOOL

Although sheep are a minor livestock enterprise in New York, on some farms they constitute an important portion of the farm business. In the 1935 Census, 12,747, or 7 per cent, of the farms in the State reported sheep. These farms had an average of 30 per farm. For all farms in the State, the average was about 2 per farm.

Sheep are largely in the western New York counties of Genesee, Livingston, Ontario, Orleans, Steuben, Wyoming, and Yates; each reported 20,000 or more head in 1935. In this area a considerable number of western and southern lambs are shipped in each fall and fed during the winter.

From the mail questionnaire, it was found that three-fourths of the sheep and lambs reported sold were in the western district where the number sold per farm was 22.4; the southern district sold approximately 7 per farm, and in no other area was the average number sold per farm more than 4 (table 30).

TABLE 30. METHODS OF SELLING SHEEP AND LAMBS
5262 New York farms, 1938
(Mail questionnaire)

District	Sheep and lambs sold		Method of selling					
	Total	Per farm	Commission companies	Dealers	Butchers	Farmers	Other	Total
			Per cent of sheep sold					
Northern	245	0.6	..	46	48	6	..	100
Northeastern	135	1.0	..	92	..	8	..	100
Western	20,374	22.4	69	15	9	3	4	100
Central	814	0.9	..	45	52	2	1	100
Eastern	1,652	3.6	1	28	54	7	10	100
Southwestern	1,448	3.0	42	36	9	12	1	100
Southern	2,248	6.8	19	47	23	11	*	100
Southeastern	418	1.3	11	31	38	19	1	100
All districts	27,334	6.2	55	22	15	5	3	100

*Less than 0.5 per cent.

In the western district 69 per cent of the sheep were sent to Buffalo, where they were sold through commission companies. In the other areas, with the exception of the southwestern district, most of the sheep were sold to dealers and butchers. Five per cent of all sheep sold were sold to farmers.

FIGURE 9. FEEDER LAMBS FROM NEW MEXICO ON A WESTERN NEW YORK FARM

Approximately 300,000 sheep were shorn in New York in 1938 and 1939. The average weight per fleece was 7.2 pounds in 1938 and 7.4 pounds in 1939. This made a total production of about 2,300,000 pounds of wool.

Wool from New York flocks has been sold largely to local wool buyers at shearing time. A state-wide cooperative has handled a considerable quantity of wool for its members for the past 20 years. This cooperative handled more than one-third of the state "clip" in 1921, reached a low of 2.5 per cent of the total production of the State in 1937, and handled about 16 per cent of the state production in 1938.

HOME-BUTCHERING

The mail questionnaire supplied information relative to the home slaughter of livestock. Hogs were butchered at the rate of about one per farm (table 31). Slightly more than one-third of all of the farms slaughtered hogs. The percentage of farms slaughtering hogs was about the same in all districts, varying from 32 per cent in the southeastern district to 44 per cent in the northern.

TABLE 31. LIVESTOCK SLAUGHTERED ON THE FARM
5262 New York farms, 1938
(Mail questionnaire)

District	Per cent of farms slaughtering—				Number slaughtered per 100 farms			
	Hogs	Cows	Calves	Sheep	Hogs	Cows	Calves	Sheep
Northern	44.4	22.5	7.7	1.6	119	25.1	13.8	4.7
Northeastern	34.2	15.8	13.3	2.5	61	25.3	39.9	17.7
Western	36.4	12.4	5.8	5.3	88	14.3	13.5	52.6
Central	34.3	16.0	9.1	1.6	71	20.0	19.5	6.9
Eastern	40.2	15.2	12.6	4.7	135	19.2	31.8	48.4
Southwestern	39.6	20.1	9.0	4.0	100	25.0	26.2	12.8
Southern	38.2	14.5	7.4	5.6	92	16.8	25.3	13.5
Southeastern	31.7	15.1	10.6	3.6	118	21.8	37.0	25.3
All districts	36.9	16.0	8.9	3.6	98	19.8	23.5	25.1

Some of the livestock butchered on the farms was sold. Of the 98 hogs butchered per 100 farms, 27 were sold and 71 kept for home use. In the eastern district, where 135 head were butchered per 100 farms, 49 were sold. In the northeastern district, where only 61 were butchered per 100 farms, only 9 were sold.

Only one-sixth of all farms butchered cows. The cows butchered amounted to about 20 per 100 farms, or an average of one-fifth cow per farm. Of these 20 butchered, 5 were sold off the farm. The variation in the number slaughtered per 100 farms varied from 14 in the western district to 25 in northern and southwestern New York.

Less than 10 per cent of the farms reported the slaughter of calves. The number slaughtered amounted to about 1 for every 4 farms. Of the 23 slaughtered per 100 farms 8 were sold, leaving 15 for home use.

More sheep than calves were butchered, but less than half as many farms did the butchering. In Wyoming and Orleans Counties, nearly two sheep were butchered per farm. In the western district, where 53 sheep were slaughtered per 100 farms, 41 were sold off the farm. For the State as a whole, 17 of the 25 sheep slaughtered per 100 farms were sold, leaving 8 per 100 farms for home use.

SUMMARY

The buying and selling of livestock in conjunction with maintaining dairy herds in New York State are the most important livestock marketing problems for New York farmers. Farmers' purchases are largely dairy cows to replace rejects from their herds. This amounted to an average of 1.8 cows per farm in 1938 or about 10 per cent of the number of cows in their herds (table 32). Many farmers raise all of their replacements; others raise none. Therefore, considerable variation exists between farms and between areas of the State in the number of replacements bought and sold.

TABLE 32. NUMBER OF LIVESTOCK BOUGHT AND SOLD FROM NEW YORK FARMS, 1938

Kind of livestock	Number bought		Number sold	
	Per 100 on hand	Per farm	Per 100 on hand	Per farm
Replacement dairy cows	10	1.8	8	1.4
Slaughter cows	..	..	12	2.2
Veal calves	..	..	72*	12.0
Sheep and lambs	..	..	..	6.2
Hogs and pigs	..	1.4	..	3.3
Horses	16	0.4	7	0.2

*Number of veal calves sold per 100 calves born.

Importations of dairy cows into New York State are about the same in number as exports from the State. Therefore, total purchases of replacement cows by farms in the State should equal total sales from farms. The survey indicated only 8 cows sold, compared with 10 cows bought, per 100 cows kept. This is partially explained by the fact that farmers may believe they are selling cows for slaughter, but some of these cows may actually get back into other dairy herds as replacements.

Farmers sold an average of more than 2 cull cows and 12 veal calves per farm. These by-products of the dairy enterprise account for the most important livestock income on New York farms.

The sale of sheep and lambs is largely from farms in western New York counties. In this area, some farmers buy and feed sheep during the winter months. In recent years, 45,000 to 50,000 have been purchased for this purpose.

Hogs and pigs are purchased largely for home-butchering. Farmers who raise more than they need for themselves sell either to their neighbors or to market. In addition to raising pork for home slaughter, there are a number of garbage-feeding establishments in the State where pork is produced on a commercial scale.

The buying and selling of horses by New York farmers is relatively unimportant and is becoming less important as horse power is being replaced by motorized equipment.

Farmers buy most of their hogs and pigs and about half of their replacement dairy cows from other farmers (table 33). Local dealers supply more than half of the horses and 42 per cent of the replacement cows. Livestock auctions, although increasing in importance, are patronized largely by livestock dealers. Farmers buy and sell little livestock through them.

TABLE 33. METHODS OF BUYING LIVESTOCK USED BY NEW YORK FARMERS, 1938

Kind of livestock	Where bought			
	Farmers	Dealers	Auctions	Total
	Per cent of animals bought			
Replacement cows	52	42	6	100
Horses	37	58	5	100
Hogs and pigs	88	9	3	100

Farmers sell more livestock to dealers than by any other method. They sold more than half of their veal calves and about half of their replacement cows, slaughter cows, and horses to dealers (table 34). Butchers bought more than one-third of the slaughter cows and veal calves. Commission companies were important, especially in the areas adjacent to terminal markets. Most of the sheep and lambs were marketed this way. Farmers sold more than half of their hogs and pigs, and about half of their replacement cows and horses direct to other farmers.

TABLE 34. METHODS OF SELLING LIVESTOCK BY NEW YORK FARMERS, 1938

Kind of livestock	To whom sold						
	Farmers	Dealers	Butchers	Auctions	Commission companies	Other	Total
	Per cent of animals sold						
Replacement cows	45	49	..	6	..	..	100
Slaughter cows	..	42	39	5	11	3	100
Veal calves	..	55	34	6	3	2	100
Horses	50	46	..	2	..	2	100
Hogs and pigs	62	8	12	2	8	8	100
Sheep and lambs	5	22	15	..	55	3	100

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